

THE IMPACT OF ATTACHMENT ANXIETY ON  
SUSCEPTIBILITY TO FALSE MEMORIES

BY

NATHAN W. HUDSON

DISSERTATION

Submitted in partial fulfillment of the requirements  
for the degree of Doctor of Philosophy in Psychology  
in the Graduate College of the  
University of Illinois at Urbana-Champaign, 2016

Urbana, Illinois

Doctoral Committee:

Professor R. Chris Fraley, Chair  
Professor Dov Cohen  
Professor Aaron S. Benjamin  
Assistant Professor Jaime L. Derringer  
Assistant Professor Michael W. Kraus

## ABSTRACT

Previous research shows that people's attachment styles predict memory functioning. For example, people with relatively insecure attachment styles tend to forget relationship-relevant information, as well as negatively bias their emotional evaluations of interpersonal experiences over time. An emerging body of research has also begun to suggest that attachment anxiety in particular relates to people's propensity to experience *false* memories. The present dissertation describes two randomized experiments which attempted to examine a causal link between attachment anxiety and false memories. Furthermore, the present studies attempted to isolate whether attachment anxiety causes false memories during memory maintenance or retrieval processes.

Participants were primed with either (1) high attachment anxiety, (2) low attachment anxiety, or (3) were not primed prior to retrieval (Study 1) or during maintenance (Study 2). The experimental primes had no main effects on false memories in either study. This may indicate that attachment anxiety does not cause false memories during maintenance or reconstruction. However, future research should explore whether attachment anxiety might cause false memories during encoding processes. Alternatively, it may be the case that the priming paradigms used failed to appropriately manipulate participants' attachment security, which would render the present findings ambiguous. Current procedures for priming attachment security and future directions for studying links between attachment anxiety and false memories are discussed.

*Keywords:* adult attachment, false memories, personality processes

**TABLE OF CONTENTS**

Chapter 1: Introduction .....	1
Chapter 2: Study 1 .....	19
Chapter 3: Study 2 .....	44
Chapter 4: General Discussion.....	55
References .....	80
Appendix A: Tables and Figures .....	94
Appendix B: Verbatim Study Materials .....	117

## CHAPTER 1: INTRODUCTION

*When I was younger, I could remember  
anything, whether it happened or not.  
-Mark Twain, 1907*

The attachment system's primary function is to regulate the formation of close bonds with *attachment figures* who provide safety and security (Bowlby, 1969; Hazan & Shaver, 1987; Mikulincer & Shaver, 2007). However, its functioning also has far-reaching impacts on a broad array of—sometimes even seemingly unrelated—psychological phenomena. Among these phenomena, previous research suggests that people's memories may be shaped by their attachment orientations. For example, existing studies show that individuals with relatively insecure attachment styles are more likely to forget and/or fail to encode relationship-relevant information (Edelstein et al., 2005; Fraley & Brumbaugh, 2007; Fraley, Garner, & Shaver, 2000).

These types of errors of *omission* (such as failing to encode and/or forgetting), however, are only one manner in which memory can fail. People can also experience errors of *commission*, such as remembering events that never occurred (e.g., Jou & Flores, 2012). The fact that attachment orientations have been shown to predict errors of omission raises the possibility that they might also predict errors of commission. This distinction has the potential to be important for attachment theory and research. For one, attachment-driven false memories have the potential to influence relationship quality and functioning. As an example, consider a relatively common scenario—an argument between two romantic partners in which one person remembers feeling subtly insulted by something their partner said, but their partner has no recollection of the purported remark. In this scenario, the allegedly offending partner may have forgotten the offensive comment (an error of omission)(e.g., Edelstein, 2006; Fraley &

Brumbaugh, 2007). Alternatively, the offended partner may have remembered an incident that *never occurred* (an error of commission). This is a potentially important nuance—errors of commission and errors of omission may operate via different mechanisms, and may have different implications for understanding adult attachment and relationship functioning (e.g., Hazan & Shaver, 1987; Mikulincer & Shaver, 2007).

Beyond affecting people's current relationships, false memories may also have the potential to bias people's recollection of their entire relational histories. Because attachment security is based in people's beliefs and expectations about close relationships (Bowlby, 1969), fallacious memories of one's relational past have the potential to shape one's current attachment style. To the extent that attachment is systematically related to errors of commission, such errors may be a potential mechanism through which individuals' attachment orientations are self-reinforcing, potentially contributing to their stability.

Despite the potential importance of errors of commission, to-date, very few studies have systematically explored whether attachment affects people's susceptibility to "remember" events that never happened (cf. Ein-Dor, Mikulincer, & Shaver, 2011). Therefore, the purpose of the present studies was (1) to examine whether people's attachment styles cause them to falsely remember events that never occurred, and (2) to explore the processes underlying the generation of such attachment-driven false memories.

### **Overview of the Attachment System in Adulthood**

Bowlby (1969) believed that the attachment system was designed to compel children—who are relatively helpless and defenseless—to seek close bonds with *attachment figures* who provide safety and security. In the years since Bowlby originally articulated attachment theory, however, researchers have found that the same attachment dynamics that are observed between

children and parents are also manifest in adult relationships—primarily with romantic partners (Hazan & Shaver, 1987; Mikulincer & Shaver, 2007), but also with other potential providers of support, such as close friends (Grabill & Kerns, 2000) or even God (Beck & McDonald, 2004). Although adults are not as helpless or defenseless as are children, the normative functioning of the attachment system—as well as individual differences therein—are believed to be largely the same in adults as in children (Hazan & Shaver, 1987; Mikulincer & Shaver, 2007).

As can be seen in Figure 1, which was adapted from Fraley and Shaver (2000), the attachment system can be conceptualized as a psychological control system that continuously asks the question, “Is an attachment figure available and responsive?” To the extent that an individual perceives that his or her attachment figure is available and responsive to the individual’s needs, that individual will experience felt security. In contrast, if the individual perceives that his or her attachment figure is unable or unwilling to provide safety and security, that individual will experience a sense of distress and anxiety. In order to assuage this distress, the individual will activate attachment behaviors that promote proximity to and provision of security from the attachment figure. These behaviors can include increasing physical and emotional closeness with the attachment figure, as well as making bids for attention, affection, and care from him or her. Once the individual feels confident that the attachment-figure is once again available and responsive, the proximity- and security-seeking behaviors are terminated.

Through relational experiences, people can develop more or less secure *working models*—beliefs and expectations—regarding the nature of close relationships (Bartholomew & Horowitz, 1991; Bowlby, 1969; Mikulincer & Shaver, 2007). These working models underlie individual differences in the functioning of the attachment system. In adulthood, individual differences in attachment orientations are typically conceptualized as varying along two distinct

continua: attachment anxiety and avoidance (Bartholomew & Horowitz, 1991; Fraley, Waller, & Brennan, 2000). As can be seen in Figure 1, anxiety<sup>1</sup> and avoidance reflect individual differences in deciding (1) whether the attachment figure is available and responsive, and (2) whether attachment behaviors are a viable solution to assuage felt attachment-related distress, respectively.

People who are high in attachment anxiety worry about the availability and accessibility of their attachment figures (Fraley, Waller, et al., 2000; Mikulincer & Shaver, 2007). Stated differently, highly anxious individuals have a low threshold for concluding that their attachment figures are unavailable or unresponsive (Fraley & Shaver, 2000). This results in an adaptive (Ein-Dor, Mikulincer, Doron, & Shaver, 2010) “hyper-activation” of the attachment system (Mikulincer & Shaver, 2007) in which highly anxious individuals are more likely to experience anxiety and distress, and as a result, are preoccupied with their relationships (Bartholomew & Horowitz, 1991), relentlessly seek close bonds with others (Hazan & Shaver, 1987), and hyper-vigilantly monitor their relationship partners for signs of availability and support vs. unresponsiveness and rejection (Fraley, Niedenthal, Marks, Brumbaugh, & Vicary, 2006). In sum, anxious individuals are quicker to activate their attachment systems (by concluding that their attachment figures are not, in fact, available or responsive) and are slower to deactivate the resultant proximity- and security-seeking behaviors (Fraley & Shaver, 2000).

In contrast, people with high levels of avoidance view attachment behaviors as a non-viable solution for assuaging the distress and anxiety that result from unwilling or unresponsive attachment figures (Fraley & Shaver, 2000). As a consequence, during times of distress, individuals high in avoidance are likely to inhibit attachment-related behaviors (e.g., proximity-

---

<sup>1</sup> Throughout this manuscript, “anxiety” always refers specifically to *attachment* anxiety—preoccupation with relationships and worry about rejection. In this manuscript, “anxiety” *never* refers to “regular” anxiety (e.g., worry, stress, or neuroticism).

and support-seeking), and are instead likely to seek solace apart from others (Bowlby, 1969; Fraley & Shaver, 2000). The result is an adaptive (Ein-Dor et al., 2010), defensive rejection of the need for attachment bonds (Fraley, Davis, & Shaver, 1998), which manifests as withdrawing from relationships and repudiating too much intimacy or interdependence (Fraley, Waller, et al., 2000; Hazan & Shaver, 1987).

Importantly, although not depicted in Figure 1, attachment avoidance influences behavior even when the attachment system is not activated (i.e., when there is no felt anxiety and distress). Because highly avoidant people do not view attachment behaviors as a viable solution to resolving attachment-related distress, over time, they may attempt to defensively eliminate the need to depend on attachment figures. Rejecting the need for close relationships circumvents the felt distress that would normatively result from attachment figures being unavailable or unresponsive (Bowlby, 1969; Fraley & Shaver, 2000). This type of defensive withdrawal from relationships can be seen in the fact that avoidant individuals are not merely apathetic toward relationships—intimacy is *uncomfortable* for them (Bartholomew & Horowitz, 1991; Fraley, Waller, et al., 2000; Hazan & Shaver, 1987) and they actively attempt to suppress thinking about relationships (e.g., Fraley et al., 1998; Mikulincer & Orbach, 1995).

In summary, across the lifespan, the attachment system compels individuals to seek close relationships with attachment figures who provide a sense of safety and security. Individual differences in attachment orientations are conceptualized as varying along anxiety and avoidance dimensions. High levels of attachment anxiety are associated with worrying about relationships and fearing rejection. High levels of attachment avoidance are associated with defensively rejecting the need for close relationships.



## Existing Research on Attachment and Memory

Numerous studies have linked people's attachment styles to memory functioning. One of the most prevalent findings in the literature is that highly avoidant individuals have difficulty in remembering relationship-relevant information—both natural episodic memories and memory for stimuli presented in the lab. With respect to episodic memory, highly avoidant individuals are slower and less-able to recall attachment-related memories from their childhoods (Edelstein et al., 2005; Haggerty, Siefert, & Weinberger, 2010; Kohn, Rholes, & Schmeichel, 2012; Mikulincer & Orbach, 1995). With respect to lab stimuli, avoidant individuals are also less able to remember details from stories containing relational themes (Fraley & Brumbaugh, 2007; Fraley, Garner, et al., 2000), interpersonal conversations (Miller, 2001), or even relationship-related word lists (Edelstein, 2006; Goodman et al., 2011; van Emmichoven, van Ijzendoorn, De Ruiter, & Brosschot, 2003). These findings have typically been interpreted to mean that, to minimize the psychological importance of attachment relationships, people high in avoidance direct their attention away from relationship-relevant stimuli and fail to encode them into memory (and thus there are fewer memories to retrieve)(Edelstein, 2006; Fraley & Brumbaugh, 2007).

In addition to errors of omission, such as forgetting, there is reason to believe that attachment orientations might also predict errors of commission, such as falsely remembering events that never occurred. For example, people with high levels of attachment anxiety—who are preoccupied with ensuring that their attachment figures are available and responsive—are chronically concerned about relationships (Fraley et al., 2006; Mikulincer & Shaver, 2007), which may lead them to encode or reconstruct a greater number of false relationally-relevant memories (e.g., Straube, 2012). However, to the best of my knowledge, only three peer-

reviewed articles have addressed the association between attachment and false-memory susceptibility—and they have all done so only tangentially in service of other primary research goals.<sup>2</sup> First, while studying people’s threat-response strategies, across two studies Ein-Dor and colleagues (2011) recruited 126 participants to watch a video of a confederate describing an incident where she encountered a threat and responded either (1) calmly [ $n = 61$ ]; (2) with a hyper-vigilant “sentinel” strategy—monitoring the threat closely [ $n = 37$ ]; or (3) with a fight-or-flight strategy [ $n = 28$ ]. After the video, participants completed a surprise memory test and were asked to indicate whether several sentences were uttered in the video or not. Half of the sentences were actually said in the video, and the other half were not. Ein-Dor and colleagues found that people with high levels of attachment anxiety were more likely to falsely remember “sentinel” sentences, and avoidant individuals were more likely to remember false “fight-or-flight” sentences.

Second, Qin and colleagues (2008) were interested in whether the efficacy of a false memory implantation paradigm (Loftus & Pickrell, 1995) would be affected (1) if participants were warned that false memories can occur and (2) if participants increased the vividness of the false memory by visualizing it. One-hundred nineteen participants’ parents provided three real stories from the participants’ childhoods, and confirmed that one of several false story options provided by the experimenter (e.g., a birthday party at McDonald’s) never happened to the participant. In an interview session, half of the participants were warned that false memories can

---

<sup>2</sup> After completion of the present studies, I also discovered one dissertation that explicitly examined links between attachment orientations and false memories (Wilson, 2006). In one study, Wilson found zero-order links between attachment anxiety and false recall for word lists (but not for details from vignettes). In her second study, these zero-order correlations were generally in the same direction but were not statistically significant. Attachment avoidance was generally unrelated to false recall on a zero-order level. Wilson also tested for interactions between security vs. insecurity primes, trait-level attachment, and stimuli-domain (attachment vs. non-attachment) in predicting false memories. Her most consistent finding was that false recall was greatest for attachment-related stimuli when highly trait-anxious individuals were primed with *security*. Although this interaction is difficult to interpret, Wilson’s zero-order findings are consistent with the idea that attachment anxiety relates to false memories.

occur. All participants were subsequently presented with a basic prompt about the three real stories, as well as one confirmed-false story. Crossed with the false memory warning, half of participants were asked to visualize all four memories. All participants rated their confidence as to whether each memory had actually occurred, and orally recounted as much detail about each memory as they could. Collapsing across conditions, Qin and colleagues found no links between participants' attachment styles and an aggregate measure of their reported confidence in the false memory and the number and clarity of details that they provided about it during the interview.<sup>3</sup>

Finally, McWilliams and colleagues (2013) were interested in the role of false rehearsal on memory recall. Three-hundred eight participants read a fictitious account of childhood sexual abuse, and either (1) correctly rehearsed the story, (2) rehearsed the story with instructions to hide the fact that abuse had occurred, or (3) did not rehearse the story. In a subsequent session, participants were asked several cued recall questions. Collapsing across conditions, both anxious and avoidant individuals provided fewer correct answers. However, anxious individuals also provided greater *incorrect* answers for non-abuse-related information. Although this finding was not a direct test of the link between anxiety and false recall (and the authors did not interpret it as such), it may imply that anxious individuals are likely to remember false relationally-relevant information.

From these existing studies, the links between attachment and false memories are unclear. Ein-Dor and colleagues (2011) found that both anxiety *and* avoidance related to susceptibility to specific types of false memories, whereas Qin and colleagues (2008) found no links between attachment and false memory. However, both studies were dramatically underpowered to detect even average-sized correlations ( $r \sim .21$ ; Richard, Bond, & Stokes-Zoota, 2003)(power ranged

---

<sup>3</sup> They did, however, find that participants whose *parents* had a highly anxious and highly avoidant (i.e., fearful) attachment style were more likely to accept the false memory as true.

from 37% [Ein-Dor et al., 2011] to 63% [Qin et al., 2008]). The lack of statistical power in these studies compromises their ability to provide clear information on the links between attachment and false memories (e.g., Button et al., 2013; LeBel & Peters, 2011). McWilliams and colleagues' (2013) study did not suffer from low power (power to detect an average-sized correlation in their study was 97%), but their study was not explicitly designed to test the association between attachment and false memory. As such, the link between attachment anxiety and provision of incorrect answers to cued-recall questions in their study should be approached as an exploratory finding—albeit one that beckons further systematic research on the topic.

To address the limitations of these studies and clarify the correlation between attachment styles and false memories, Hudson and Fraley (in preparation) recruited 264 participants to watch a 20-minute video of a woman telling the story of her recent breakup. Afterward, participants were presented with a surprise 50-item memory test. Each item described an event that either occurred in the video (e.g., “Victoria said that James was involved in planning their wedding”) or did not occur in the video (e.g., “According to Victoria, James told her that he would never leave her”). Participants were asked to rate, on a binary scale, whether each event occurred or did not occur.

A multilevel logistic model was used to examine how the probability of endorsing items *as having occurred* varied as a function of (1) the item's veracity [true vs. false], (2) people's attachment anxiety and avoidance, (3) the interactions between the attachment dimensions and item veracity, and (4) a random intercept term, which modeled each individual's overall propensity to endorse items.<sup>4</sup> Results indicated that individuals high in attachment anxiety had

---

<sup>4</sup> As is discussed in greater depth in the Study 1 analyses, this analysis simultaneously modeled the impact of the attachment dimensions on (1) false alarm rates, (2) memory sensitivity [the interaction term, which represents *hit rate – false alarm rate*], and (3) memory bias [a linear combination of the simple effect of attachment on false alarm rates and the interaction term].

higher *false alarm rates* (i.e., odds of endorsing false items; simple odds ratio [OR] = 1.15, 95% confidence interval [CI] [1.06, 1.26]), but not higher *hit rates* (i.e., odds of endorsing true items; simple OR = 1.04, 95% CI [0.96, 1.12])(and there was a significant interaction between anxiety and item-veracity, OR = 0.90, 95% CI [0.82, 0.99]). These model-predicted odds can be transformed into more easily interpretable predicted probabilities. As can be seen in Figure 2, the predicted probabilities of endorsing false items (i.e., false alarm rates) at one *SD* below and above the mean of attachment anxiety were 14% and 18%, respectively. In contrast to the anxiety findings, avoidance was not significantly related to false alarm rates, OR = 0.94, 95% CI [0.86, 1.03]. Collectively, these findings suggest that it is anxiety, in particular, that relates to false memory susceptibility (e.g., McWilliams et al., 2013; Wilson, 2006). The proposed studies build upon these findings by systematically exploring the processes through which attachment anxiety might interact with memory processes to produce false memories.

### **A Model of Attachment and False Memory Susceptibility**

What processes might link attachment anxiety to false memories? On the broadest level, memory consists of three stages: encoding, maintenance, and retrieval. Errors in any of these stages can produce false memories (Straube, 2012). Figure 3 depicts a model of how people's attachment orientations might be expected to interact with memory processes to promote false memories. Specifically, it is possible that people's attachment styles might interface with any or all of the stages of memory, potentially injecting false memories at any stage. I will discuss each stage of memory separately.

#### **Encoding**

Information about experiences is encoded into memory at various levels of specificity. For any given experience, the brain is thought to create *verbatim traces* that store exact, specific

details about the experience (Brainerd & Reyna, 2002; Straube, 2012). Additionally, the brain is also thought to create “fuzzier” *gist traces* which capture the general ideas, themes, or meanings of experiences—and these gist traces are thought to be susceptible to the effects of spreading activation at the time of memory creation (Brainerd & Reyna, 2002; Straube, 2012). As a concrete example, studies using the Deese-Roediger-McDermott (DRM) paradigm present participants with lists of words that have a theme in common. For example, the list of words, “bed, rest, awake, tired, dream, wake, snooze, blanket, doze, slumber, snore, nap, peace, yawn, drowsy” all relate to the theme of *sleep*, although the word “sleep” is surreptitiously absent from the list. Nevertheless, if participants are presented with those 15 words and asked to free-recall the words they saw, about 60% will falsely remember that the word “sleep” was present (Stadler, Roediger, & McDermott, 1999). This effect is thought to occur because the brain creates verbatim traces for the words *actually* on the list, as well as a gist trace that the list is generally about “sleep.” This gist trace is partially a function of the concepts that are most salient as a result of spreading activation. At the point of recall, the gist trace may produce a memory that is equally as compelling as those produced by the verbatim traces (Brainerd & Reyna, 2002), creating a strong subjective experience that the word “sleep” was, in fact, on the list.

As is depicted in Figure 3, people’s attachment orientations might be expected to shape encoding in two ways. First, individuals’ attachment orientations may affect which details they attend to, and thus encode into verbatim traces. For example, previous research suggests that insecurely attached individuals may fail to attend to (and thus also fail to encode) details that pertain to relational stimuli (Edelstein, 2006; Fraley & Brumbaugh, 2007; Fraley, Garner, et al., 2000). Individuals with high levels of attachment anxiety in particular may selectively focus their attention toward rejection- or emotion-related information (Fraley et al., 2006), and thereby

fail to encode other details. This alone might bias highly anxious individuals' memories such that their memories of events are more permeated with emotions or cues suggesting rejection, as compared with relatively secure individuals' memories for the same events. Moreover, encoding fewer verbatim traces may force insecurely attached individuals to rely more on gist traces during retrieval, potentially leading to retrieval of false information that is consistent with the gist traces (Brainerd & Reyna, 2002).

Second, people's attachment styles might directly affect the meaning and interpretation that they ascribe to their interpersonal interactions—and thus people with high levels of attachment anxiety may encode gist traces containing qualitatively different content than those encoded by their more secure peers. For instance, highly anxious and highly avoidant individuals perceive interpersonal interactions and others' motives more negatively (Collins, Guichard, Ford, & Feeney, 2004; Pereg & Mikulincer, 2004). In one experiment, participants were placed into a stressful situation (preparing and giving a videotaped speech). Their romantic partners were instructed to write them supportive notes. Controlling for independent judges' ratings of how supportive the notes actually were, insecurely attached individuals perceived the notes to be significantly less supportive than did their more secure counterparts (Feeney & Collins, 2001). In a different study, highly anxious individuals were more likely to attribute negative relationship experiences to internal, stable flaws in their partners (Pereg & Mikulincer, 2004). To the extent that individuals high in attachment anxiety construe the meaning or gist of an interaction more negatively, this bias may be encoded into gist traces, potentially producing false memories upon retrieval (Straube, 2012).

To summarize, insecurely attached individuals may (1) encode fewer verbatim traces, forcing them to rely more upon gist traces upon retrieval, (2) selectively encode verbatim traces

that pertain to emotions and rejection, and/or (3) encode gist traces containing qualitatively different content than do their more secure peers. Any of these phenomena could potentially produce false memories.

## **Maintenance**

False memories might also potentially be created during memory maintenance processes—through both interference and consolidation (Straube, 2012). With respect to interference, old memory traces can be corrupted when new memories are encoded (Loftus & Palmer, 1974; Wright & Loftus, 1998; Zaragoza, Mitchell, Payment, & Drivdahl, 2011). For example, in one famous experiment, Loftus and Palmer (1974) showed participants a video of two automobiles colliding, in which no glass was shattered. In follow-up questions, they asked some participants about the events that occurred when the cars “smashed;” other participants were asked what happened when the cars “collided” or “bumped.” One word—“smashed”—was enough to corrupt participants’ existing memory traces, causing them to falsely remember seeing shattered glass in the video when asked in a follow-up session one week later.

With respect to consolidation, even in the absence of nefarious experimenter intervention, natural memory consolidation processes—such as those that occur while sleeping—can create false memories when new memories are reorganized, consolidated, and linked to existing memories (Straube, 2012; Wagner, Gais, Haider, Verleger, & Born, 2004).

As depicted in Figure 3, people’s attachment orientations might be expected to affect the maintenance of memory traces over time. People with insecure attachment styles may be especially likely to corrupt or bias relationally-relevant verbatim and gist traces. Supporting this idea, a growing body of literature suggests that insecurely attached individuals’ emotional evaluations of interpersonal experiences become negatively biased over time. Several different



studies have asked participants to engage in a discussion with their parents (Dykas, Woodhouse, Ehrlich, & Cassidy, 2010), peers (Dykas, Woodhouse, Ehrlich, & Cassidy, 2012; Feeney & Cassidy, 2003), romantic partners (Simpson, Rholes, & Winterheld, 2009), or even therapists (Woodhouse & Gelso, 2008), and subsequently rate their emotional evaluations of the interaction both (1) immediately and (2) after a delay (ranging from days to months). These studies all converge on the finding that people with high levels of attachment anxiety and/or avoidance rate the experiences more negatively after a time delay than they do immediately after the interaction. These findings are consistent with the notion that, during memory consolidation processes, individuals high in attachment anxiety or avoidance bias their memory traces to include more negativity. To the extent that gist traces are negatively biased over time, or verbatim traces are corrupted through interference, individuals may construct false memories upon retrieval.

### **Retrieval**

Finally, false memories can also be generated during memory retrieval processes—in both free-recall and recognition paradigms (Straube, 2012). For one, people's gist traces may seem as strong and subjectively compelling as their verbatim traces (Brainerd & Reyna, 2002). This may lead individuals to remember false details that are consistent with the general meaning, theme, or gist that they had ascribed to the memory being retrieved (which as discussed above, may have been biased or corrupted by encoding and maintenance conditions). Beyond this, people's intrapersonal and external circumstances can affect which memory traces are available and active during retrieval (Dell, 1986). Straube (2012) argued that this can produce source memory confusion (Johnson, Hashtroudi, & Lindsay, 1993), leaving people with the difficult task of discerning which memory traces are active due to extraneous factors such as spreading activation, and which are directly relevant to the memory being retrieved.

As depicted in Figure 3, people's attachment orientations might be expected to also influence how they reconstruct the specific details of remembered experiences from their gist traces. There are several reasons to expect such a phenomenon. First, spreading activation from feelings of insecurity at the time of memory retrieval may bias anxious individuals toward recalling false, insecurity-related events. Second, it is possible that insecure individuals encode fewer verbatim traces (e.g., Edelstein, 2006; Fraley & Brumbaugh, 2007; Fraley, Garner, et al., 2000), and thus are forced to rely more upon gist traces during retrieval, which may lead to generation of false, gist-consistent details. Third and finally, even assuming equivalent gist traces, insecure individuals may be biased toward constructing more negative details from those gist traces, and thus endorsing a greater number of false memories (e.g., given a negative gist trace, anxious individuals might construct details consistent with internal, stable characteristics of their partners vs. details that emphasize temporal, situational influences [e.g., Pereg & Mikulincer, 2004]). Of course, these possibilities are not mutually exclusive, and could potentially all contribute to generation of false memories during retrieval.

### **Special Considerations for Empirically Studying Attachment and False Memories**

There are at least two complexities that must be considered when studying the empirical links between people's attachment orientations and their susceptibility to false memories. First, although errors can occur in any stage of memory, the resultant false memories are only manifest upon retrieval. That is, false memories can only be measured post-retrieval, irrespective of whether those false memories resulted from errors in encoding, maintenance, or retrieval. As such, it is difficult to determine in which stage of memory any one specific false memory was produced. Second, because people's attachment orientations are trait-like and relatively stable (Fraley, 2002; Fraley & Brumbaugh, 2004; Fraley, Vicary, Brumbaugh, & Roisman, 2011), it is

difficult to know whether the observed correlations between attachment anxiety and false memories (e.g., Hudson & Fraley, in preparation) are causal, and—if so—whether the causal influence of attachment anxiety is occurring during encoding, maintenance, retrieval, or any combination of the three.

Fortunately, neither of these issues is insurmountable. Previous research suggests that people's state-level attachment orientations can be temporarily shifted in the laboratory using priming manipulations (e.g., Baldwin, Keelan, Fehr, Enns, & Koh-Rangarajoo, 1996; Carnelley & Rowe, 2007; Gillath et al., 2006; Gillath, Selcuk, & Shaver, 2008). These priming manipulations are based in the fact that, even though people have general or global attachment orientations, most people have experienced relationships or episodes within relationships in which they have felt relatively high and low levels of attachment anxiety and avoidance (Baldwin & Fehr, 1995; Pierce & Lydon, 2001). Previous research suggests that priming those relationships or episodes of high/low anxiety/avoidance can manipulate people's state levels of attachment security, causing them to temporarily react and behave in ways that are consistent with the primed attachment style (e.g., Baldwin et al., 1996; Carnelley & Rowe, 2007; Gillath et al., 2006, 2008; Gillath, Sesko, Shaver, & Chun, 2010; Luke, Sedikides, & Carnelley, 2012; Mikulincer, Gillath, et al., 2001).

Based on these ideas, in the present studies, I attempted to manipulate participants' state-level attachment styles during various stages in the memory process. By manipulating people's attachment styles at different points in the memory process (depicted in Figure 3), the influence of attachment on each stage of memory can be isolated. For example, in Study 1, participants watched a video, encoding its contents into their memories. In a later session, participants were randomly assigned to be primed with high or low state-levels attachment anxiety, or to

experience no prime. Subsequently, they completed a recognition memory test. Because participants encoded their memories *before* the manipulation and the primes were immediately prior to the memory test, any systematic differences between the prime groups in false memories must be due to state-level anxiety influencing the reconstruction and retrieval of memories, rather than the encoding or maintenance thereof.

This methodology has two benefits. First, because people's state levels of attachment anxiety were experimentally manipulated, the present studies have relatively high internal validity, enabling confident causal inferences. Second, because people's attachment anxiety was manipulated at several points in the memory process, the influence of attachment on individual stages of memory can be assessed.

### **Overview of the Present Studies**

The present studies experimentally tested two predictions drawn from my model of the influence of the attachment system on false memories (Figure 3). These studies were designed to understand the processes of *how* attachment anxiety might produce false memories by exerting its influence on different stages of memory. Several existing studies already support the notion that people's attachment styles color their perceptions of interpersonal experiences (e.g., Feeney & Collins, 2001; Miller & Noiro, 1999; Pereg & Mikulincer, 2004)—which, sans correction mechanisms, seems to suggest that the attachment system can bias the way people encode the meaning of experiences into gist traces. So, instead, the present studies focused on two of the more untested propositions of my model about how attachment anxiety might affect the maintenance and reconstruction of memories.

Working backward through the model illustrated in Figure 3, Study 1 examined whether and how people's attachment styles affect the reconstruction of specific memory details from gist

traces. Using Hudson and Fraley's (in preparation) paradigm, participants viewed a 20-minute video of a woman describing a breakup. Immediately afterward, they rated their gist impressions of the characters in the story. In a separate session two days later, participants rerated their gist impressions of the characters in the story and subsequently completed a surprise recognition memory quiz about events that occurred in the video. Crucially, before completing the memory quiz, participants were randomly assigned into three groups. For two groups, state-attachment anxiety was manipulated toward high- or low-state levels (Baldwin et al., 1996; Gillath et al., 2006, 2008), and the other group served as an unprimed control. Thus, any differences between groups in false alarm rates in Study 1 can be attributed to people's state attachment anxiety influencing their reconstruction of memories.

Study 2 examined how people's attachment styles affect the maintenance of their gist traces over time. Using a similar paradigm to Study 1, participants viewed the 20-minute video and rated their gist impressions of the characters. In a separate session, participants received either a high- or low- anxiety prime or no prime, and subsequently rerated their gist impressions of the characters and completed the surprise memory quiz. These data allowed me to examine whether and how state-level attachment anxiety influences *changes* in people's gist impressions over time.

## CHAPTER 2: STUDY 1

Study 1 was designed to examine whether people's attachment orientations influence retrieval and reconstruction of memories, potentially producing false memories. Study 1 was a three-group randomized experiment. Participants watched a 20-minute video in which a woman described a tumultuous romantic relationship and resultant breakup. During a second session two days later, immediately prior to completing a surprise recognition memory test, some participants were primed to experience high state-levels of attachment anxiety. Two control groups were employed—one was primed with attachment security (i.e., low state-levels of anxiety), and the other was not explicitly primed.

What should we expect to find? To the extent that attachment anxiety promotes injection of false memories during reconstruction, we would expect individuals primed with high anxiety to endorse a greater number of false items, as compared with people in either control group. Because the manipulation occurred *after* people rated their gist impressions and immediately prior to the memory quiz (see Figure 3), such a finding would support the idea that people high in attachment anxiety reconstruct greater numbers of false details from their gist traces and/or mistakenly attribute their chronically activated insecurity as being relevant to the memories being retrieved. This may be due to spreading activation from feelings of insecurity created by high anxiety at the time of retrieval biasing or desensitizing people's memories (e.g., Straube, 2012). If, however, the previously observed links between attachment and false memories (Ein-Dor et al., 2011; Hudson & Fraley, in preparation; McWilliams et al., 2013) are *not* due to errors during reconstruction (but rather errors in other stages of memory), we would expect no differences between the high-anxiety group and the control groups in false alarm rates.

## Method

### Participants

Participants were recruited in two ways. First, students registered in University psychology courses could participate through the psychology subject pool in order to partially fulfill course requirements and/or earn extra course credit. Second, text ads were posted in the psychology building and on the psychology subject pool website. Ad respondents could earn \$10 by fully completing both study sessions. Careful records were kept to prevent double participation. All participants were required to have normal or corrected-to-normal hearing and fluency in English to ensure that they could adequately hear and understand the memory stimuli.

Prior to collecting data, based on power analyses, I decided to collect a minimum of 200 participants per study, and a maximum of 260 participants per study. Specifically, 200 participants would enable approximately 85% power to detect average-sized associations ( $r \sim .21$ ;  $d \sim .42$ ; Richard et al., 2003) for analyses comparing the high-anxiety prime group to both other groups (security prime, unprimed control) collapsed together. However, power for analyses examining the groups separately would be somewhat lower: approximately 68%. A more ideal sample of 260 participants would afford 80% power to detect average-sized differences between the three individual groups. Based on these power analyses, a minimum of 200 participants were collected in each study; the precise number of additional participants in each study was determined by the number that could be recruited before the end of the semester.

A total of 265 participants completed the first session of Study 1. Of those, 231 (87%) also completed the second session. Seventy-six percent of the final sample completed the study for course credit, and the remaining participants were paid. Participants' ages ranged from 18 to 56 ( $M = 19.74$ ,  $SD = 3.49$ ). The sample was predominantly female (77%), and the racial

composition was 56% White, 27% Asian, 10% Black, and 9% Hispanic. Sixty-one percent of the sample indicated that they were not currently involved in a romantic relationship. The remaining participants indicated that they were in a committed (35%) or casual (4%) romantic relationship.

## Measures

**Attachment orientations.** Participants' attachment styles were assessed in two ways. First, participants completed the 12-item ECR Short Form (ECR-S; Wei, Russell, Mallinckrodt, & Vogel, 2007) which measures general-romantic attachment orientations in a way that is consistent with the vast majority of contemporary adult attachment literature. Second, participants completed the 9-item partner-specific and 9-item global subscales from the ECR Relationship-Structures questionnaire (ECR-RS; Fraley, Heffernan, Vicary, & Brumbaugh, 2011). These subscales measure participants' attachment styles specifically with respect to their current (or, if single, most recent) romantic partners, as well as their global attachment security across all close relationships, respectively. As such, the major difference between these three measures is the level of specificity at which attachment representations are assessed, with global being the broadest, and partner-specific being the narrowest. All three of the attachment measures contained subscales for attachment anxiety (e.g., "I often worry that my romantic partner doesn't really care for me") and attachment avoidance (e.g., "I prefer not to show my romantic partner how I feel deep down"). All items were rated using a Likert scale running from "strongly disagree" (1) to "strongly agree" (5). Items were averaged to form composites for general-romantic attachment anxiety ( $\alpha = .70$ ) and avoidance ( $\alpha = .78$ ), partner-specific attachment anxiety ( $\alpha = .84$ ) and avoidance ( $\alpha = .83$ ), and global attachment anxiety ( $\alpha = .86$ )



and avoidance ( $\alpha = .79$ ).<sup>5</sup> My primary analyses included the ECR-S (general-romantic) attachment variables; however, the ECR-RS partner-specific subscales were used to directly replicate Hudson & Fraley's (in preparation) previous studies.

**Personality traits.** Participants provided self-report ratings of their personality traits using a combination of the Ten Item Personality Inventory (TIPI; Gosling, Rentfrow, & Swann, 2003)(for extraversion, conscientiousness, and openness) and the Big Five Inventory (BFI; John & Srivastava, 1999)(for agreeableness and emotional stability). Sample items include “I see myself as extraverted, enthusiastic” (extraversion) and “I see myself as someone who has a forgiving nature” (agreeableness). All items were rated using a Likert scale ranging from “strongly disagree” (1) to “strongly agree” (5). Items were averaged to form composites (all TIPI  $\alpha$ s  $\geq .41$ ;<sup>6</sup> all BFI  $\alpha$ s  $\geq .74$ ). These data were collected for archival/review purposes, and were not analyzed in the present manuscript.

**Demographics.** Participants' gender, age, race, relationship status, relationship length (if applicable), partner gender (if applicable), SAT and ACT scores (as a proxy for IQ), country of origin, English ability, and hearing ability were assessed via self-report.

**Gist impressions.** After listening to a video of a woman named Victoria describing her relationship and breakup with a man pseudonymed “James,” participants rated their gist impressions of both Victoria and James. Specifically, participants rated Victoria's and James's: [1] personality traits, using a combination of the TIPI (6 items) and BFI (17 items; e.g., “I see Victoria as someone who is anxious, easily upset”); [2] attachment security, using a shortened

---

<sup>5</sup> In this sample, general-romantic and partner-specific working models were high similar constructs (anxiety  $r = .74$ , avoidance  $r = .78$ ). This may reflect that the sample was largely young individuals who may have had relatively few prior romantic partners. Global working models were somewhat more differentiated from both general-romantic (anxiety  $r = .52$ , avoidance  $r = .36$ ) and partner-specific models (anxiety  $r = .60$ , avoidance  $r = .46$ ).

<sup>6</sup> The TIPI was designed to assess each dimension as broadly as possible using only two items. As such, it sacrifices reliability (i.e., redundancy between the items) in order to provide a more holistic measure of each domain.

and modified version of the ECR-RS (6 items; e.g., “I see James as someone who doesn’t feel comfortable opening up to romantic partners); [3] supportive behavior, in terms of serving as a secure base and safe haven for romantic partners (3 items; e.g., “I see James as someone who would make his romantic partner feel better when they are upset”)(Fraley & Davis, 1997), and [4] morality-related trait-descriptive adjectives (18 items; e.g., “I see James as someone who is honest;” “I see Victoria as someone who is loyal”). This amounted to a total of 100 items (50 per character), each of which was rated on a Likert scale from “strongly disagree” (1) to “strongly agree” (5).

Although these items measure a variety of different constructs, they all assess general impressions of Victoria and James. Furthermore, there is a relatively clear positive and negative pole for each of these dimensions—even for personality traits (Dunlop, Telford, & Morrison, 2012). As a result, the extent to which participants universally rated Victoria and James more positively or negatively across all items provides an assessment of the general valence of their gist impressions of the characters. To ensure that all items tapped into participants’ general positive vs. negative gist impressions, principal axis factor analyses were conducted.

This measure was administered a total of four times—twice in both Study 1 and Study 2. To increase the reliability of the measure, separate principal axis factor analyses were conducted on data from each of the four administrations of the measure.<sup>7</sup> Item loadings from all four factor analyses were averaged together, and items with mean loadings  $|\lambda| \geq .30$  on the first unrotated factor were reversed-keyed as necessary and averaged together with unit weighting to form three composites representing the positivity/negativity of people’s gist impressions of [1] Victoria (43-

---

<sup>7</sup> The data were not collapsed into one large dataset for a single factor analysis because there is dependency between people’s Time 1 and Time 2 responses to each item, which might affect the pattern of loadings in a single, combined factor analysis.

item  $\alpha = .94$ ), [2] James (40-item  $\alpha = .94$ ), and (3) overall gist impressions of both Victoria and James (83-item  $\alpha = .93$ ).<sup>8</sup>

## Procedure

Participants scheduled two sessions exactly two days apart. In the first session, participants were presented with the cover story that the study was designed to examine whether people can accurately rate someone else's personality just by watching them tell a story—and that we were studying whether and how those ratings change over time. Participants first completed all attachment, personality, and demographic measures. Subsequently, participants watched a 20-minute video in which a woman, Victoria, described a true story of a very tumultuous relationship and resultant breakup with a man pseudonymed “James.”<sup>9</sup> The specific video used was chosen because it was engaging and contained detailed descriptions of several episodes in Victoria and James's relationship from which memory test questions could be generated. Furthermore, the video was deeply permeated with themes relevant to attachment anxiety (e.g., difficulty letting ex-partners go), avoidance (e.g., James behaving in ways to minimize closeness and maximize distance), and security (e.g., after breaking up with James, Victoria enters a new relationship with a responsive, caring man). After watching the video, participants completed the gist impressions measure.

---

<sup>8</sup> Of the 50 items for Victoria, a total of 43 items loaded as expected (i.e., positive items [e.g., conscientiousness] loading positively and negative items [e.g., neuroticism] loading negatively). Seven items were *not* included in the composite due to low loadings: (1) “reserved/quiet” [extraversion]; (2) “worries that romantic partners won't care for her” [anxiety]; (3) “worries that romantic partners won't care for her as much as she cares for them” [anxiety]; (4-6) all avoidance items; and (7) “passive” [moral]. For James, a total of 39 items loaded as expected. Ten items were *not* included in the composite: (1) “extraverted/enthusiastic” [extraversion]; (2) “worries a lot” [neuroticism]; (3) “gets nervous easily” [neuroticism]; (4) “conventional/uncreative” [openness]; (5-7) all anxiety items; (8) “finds it easy to depend on romantic partners” [avoidance]; (9) “prefers not to show romantic partners how he feels deep down” [avoidance]; and (10) “passive” [moral]. Furthermore, one additional extraversion item was included in the composite, but did not load as expected: the reversed extraversion item “reserved/quiet” loaded negatively, such that *introversion* was seen as positive.

<sup>9</sup> Victoria never mentions the man's name in the video. However, in all instructions and questionnaires provided to participants, the man was referred to as “James.” This was done to disambiguate James from a “new boyfriend” that Victoria mentions at the end of the video, as well as to enable questions and prompts to easily reference James.

In a second session two days later, participants first rerated their gist impressions of Victoria and James. Subsequently, some participants received a prime designed to increase or decrease their state-levels of attachment anxiety (Baldwin et al., 1996; Carnelley & Rowe, 2007; Gillath et al., 2006, 2008). To disguise the purpose of the prime, participants were provided with a cover story that we were interested in how the vividness of their imagination for certain elements of experiences (e.g., sounds, vision, emotions) relates to their judgments of others' personalities. Following the procedures created by Baldwin and colleagues (1996), participants were randomly assigned to imagine an experience in a close relationship (e.g., with a family member, romantic partner, or best friend) in which the participant felt high levels of attachment anxiety or high levels of security (i.e., low attachment anxiety), as defined in the descriptive paragraphs created by Hazan and Shaver (1987). Specifically, participants primed with high anxiety were asked to recall an experience in a relationship with a family member, romantic partner, or close friend, which matched the following description:

“I felt the person was reluctant to get as close as I would have liked. I felt worried that the person didn’t really love me, or that they might try to distance themselves from me—perhaps even abandon me. I would’ve liked to have felt very close with this person, and I worried that my desire to be close might scare them away.”

Participants primed with security (i.e., low anxiety) were asked to recall an experience in a relationship with a family member, romantic partner, or close friend, which matched the following description:

“I felt the person was relatively easy to feel close to. I felt comfortable depending on them and having them depend on me. I felt confident they really loved me and would not abandon me and would not try to distance themselves from me. I felt comfortable with the level of closeness that we both wanted in the relationship.”

Henceforth, for semantic simplicity, I refer to this latter prime as the “security prime;” however, it is important to note that security merely represents low levels of attachment anxiety,<sup>10</sup> and is not categorically different from anxiety (Fraley, Hudson, Heffernan, & Segal, 2015). During the prime, participants were first asked to write about and reflect upon the memory for a minimum of 90 seconds (although they could take longer, if desired). Subsequently, following the procedures outlined by Baldwin and colleagues (1996), participants were guided (via a 5:30 minute audio recording) through a visualization process, visualizing their surroundings in the recalled memory, imagining the sights and sounds from the memory, and critically, remembering how they felt during the recalled instance. Previous research suggests that this type of prime activates thought processes and goals consistent with the primed attachment style (e.g., Baldwin et al., 1996; Carnelley & Rowe, 2007, 2010; Gillath et al., 2006, 2008, 2010; Grau & Doll, 2003; Luke et al., 2012; McClure, Bartz, & Lydon, 2013; Mikulincer, Gillath, et al., 2001; Mikulincer, Shaver, Gillath, & Nitzberg, 2005; Park, 2007; Selterman & Maier, 2013). To reinforce the cover story, participants were asked about the vividness of their imagination for the sights, sounds, and emotions evoked by the incident. As a type of

---

<sup>10</sup> Attachment security represents low anxiety *and* low avoidance. However, the “high anxiety” prime described a prototypically *preoccupied* relationship—in which anxiety was high and avoidance was *low* (e.g., the self wants a close relationship but fears rejection). As such, both primes primed low levels of avoidance and only differed in terms of priming high anxiety (i.e., preoccupation) or low anxiety (i.e., security).

manipulation check, participants were also asked to rate the positivity/negativity of the visualization experience, and the positivity/negativity of the memory that they recalled. In addition to the two primed groups, a third group served as an unprimed control group, and did not recall a memory or engage in any visualization exercise. The control group was given a similar cover story: that we were interested in how their visual and auditory perception related to their judgments of others' personalities. The control group listened to a 4:40 minute instrumental audio clip (this same instrumental music was played in the background of the visualization primes), viewed an abstract oil painting containing no discernable shapes or themes for 60 seconds, and wrote about their general perceptions of the audio clip and visual stimuli for a minimum of 60 seconds. These participants also rated the positivity/negativity of the audio and image. As such, all three groups spent roughly a minimum of 7 minutes engaging in a combination of tasks that included listening to audio, writing about their experiences, and rating the positivity/negativity of their experiences.

Immediately after the priming task, all participants completed a surprise 54-item memory test adapted from Hudson and Fraley's (in preparation) previous studies. Participants were presented with events that either occurred in the video (e.g., "According to Victoria, James told her that she should kill herself") or did not occur in the video (e.g., "According to Victoria, James told her that he never really loved her"). Participants were instructed to rely solely upon what Victoria had actually said in the video, and to not attempt to infer whether the items may or may not have been true. Participants used a binary scale to rate whether each event occurred ("1") or did not occur ("0") in the video. The primary analyses examined participants' *false alarm rates* (i.e., endorsement of false items) and *hit rates* (i.e., endorsement of true items) during the quiz. Importantly, because the priming manipulation occurred *after* people had

encoded the video contents into memory and reported their gist impressions and *immediately* prior to the memory test (see Figure 3), differences in participants' hit rates and false alarm rates across conditions reflect the effects of state-level attachment anxiety on memory processes that occur during reconstruction and retrieval. Participants' reaction time to respond to each item on the memory test was also measured for archival/review purposes, although these data were not analyzed in the present manuscript.

For the purposes of exploratory follow-up analyses, the items were divided into 8 groups: true/false  $\times$  positive/negative  $\times$  gist-consistent/gist-inconsistent. With respect to the latter factor, some of the items (whether true/false and positive/negative) were written to be consistent with gist of the story (e.g., "Victoria said that James had no control over any aspect of his life" [false, negative]), or inconsistent with the gist of the story (e.g., "Victoria said that James was involved in the planning of their wedding" [true, positive]). Although my primary analyses collapsed across these positive/negative and gist-consistent/inconsistent factors, exploratory follow-up analyses examined whether positive/negative and gist-consistent/inconsistent items were falsely recognized at higher rates. After completing the memory test, all participants were thanked, debriefed, and compensated.

### **Analysis Strategy**

All analyses for Study 1 were conducted using multilevel logistic models (MLLMs). In these analyses, I modeled participants' log-transformed odds of *endorsing* individual items in the memory test *as having occurred* as a function of whether the item was true or false (dummy coded 1 = true, 0 = false), the prime the participant had received (dummy coded with "flag" variables; e.g., *high\_anxiety\_prime* = {1 if in high anxiety prime group; 0 otherwise}; *security\_prime* = {1 if in the security prime group; 0 otherwise}), and the participant's

standardized trait attachment anxiety and avoidance. To be clear, the dependent variable modeled was participants' probability of *endorsing items as having occurred*—it was **not** participants' odds of *correctly* identifying items as true or false. As a concrete example, the MLLM for the primary analysis in Study 1 was:

$$\ln\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = b_0 + b_1(true)_{ij} + b_2(high\_anxiety\_prime)_j + b_3(high\_anxiety\_prime)_j(true)_{ij} + b_4(trait-anxiety)_j + b_5(trait-avoidance)_j + U_j + \varepsilon_{ij}$$

In this model, the  $b_1(true)$  coefficient provides an estimate of the extent to which participants *in the control groups*<sup>11</sup> correctly identified each item as true or false (more literally, the  $b_1$  parameter represents control participants' relative odds of endorsing true items over false ones). We should expect a *positive*  $b_1$  parameter in all analyses, which would indicate that participants' *hit rates* (i.e., endorsement of true items) were higher than their *false alarm rates* (i.e., endorsement of false items).

The  $b_2(high\_anxiety\_prime)$  coefficient provides an estimate of the extent to which the anxiety prime increased or decreased participants' *false alarm rates*<sup>12</sup> as compared both control groups combined together (security prime, unprimed control). For example, a statistically significantly positive  $b_2$  coefficient would indicate that people in the anxiety prime condition had higher false alarm rates than did people in the control groups.

Finally, the  $b_3(high\_anxiety\_prime)(true)$  interaction coefficient provides an estimate of the extent to which the item being true—as opposed to false—moderated the effect of the prime.

---

<sup>11</sup> Because the *high\_anxiety\_prime* variable was dummy-coded with “control groups” as the reference group (0 = either control group, 1 = high anxiety prime group), and the interaction between the *high\_anxiety\_prime* and *true* variables was included, the  $b_1$  coefficient represents the simple effect of an item being true (vs. false) when the *high\_anxiety\_prime* variable is set to 0 (i.e., in the control groups). The simple effect of items being true vs. false in the high anxiety prime group is equal to  $b_1 + b_3$ .

<sup>12</sup> Because the *true* variable is dummy-coded with “false” as the reference group (0 = false, 1 = true), and the interaction between the *high\_anxiety\_prime* and *true* variables is included, the  $b_2$  coefficient represents the simple effect of the high anxiety prime, when the *true* variable is set to 0 (i.e., for false items).



Stated more simply, the  $b_3$  coefficient indicates the extent to which the anxiety prime had a *different* effect on participants' hit rates, *relative to* its effect on their false alarm rates (i.e.,  $b_2$ ).

As a result, the simple effect of the prime on *hit rates* is  $b_2 + b_3$ . For example, if  $b_2 = 0.20$  and  $b_3 = -0.20$ , this pattern of results would indicate that the anxiety prime [1] increased participants' *false alarm rates* ( $b_2 = 0.20$ , OR = 1.22), but [2] had absolutely no impact on their *hit rates* ( $b_2 + b_3 = 0.20 - 0.20 = 0.00$ , OR = 1.00).

One particularly elegant feature of this MLLM is that, in addition to modeling the impact of the high anxiety prime on false memories, it also simultaneously models the effect of the prime on memory sensitivity and bias. Specifically, from a signal detection theory (SDT) perspective (e.g., Macmillan & Creelman, 1991), false memories might be caused by memory *bias* (i.e., lower threshold for determining that an item is, in fact, remembered), and/or memory *insensitivity* (e.g., while reconstructing memories, individuals with poorer memory traces may be essentially forced to “guess” more about what is and is not truly remembered, deflating their hit rates and inflating their false alarm rates). Bias is typically operationalized as the *sum* and/or *average* of the hit rate and false alarm rate (i.e., the overall endorsement rate). Sensitivity is typically operationalized as the *difference* between the hit rate and false alarm rate. Of course, bias and sensitivity are not mutually-exhaustive explanations for false memories, and it is possible that false memories can be produced through processes other than bias or memory insensitivity (Dobbins, Khoe, Yonelinas, & Kroll, 2000; Straube, 2012).

In my model, the  $b_1$  (item-veracity) coefficient is a measure of sensitivity (hit rate – false alarm rate) in the control group. Furthermore, the  $b_3$  (*high\_anxiety\_prime*  $\times$  *true*) interaction coefficient provides a measure of how sensitivity is affected (i.e., increased or decreased) by the attachment anxiety manipulation. With respect to bias (i.e., overall tendency to endorse true and

false items), individual differences in bias are modeled (and controlled) by the random intercept ( $U_j$ ). Furthermore, the impact of the anxiety prime on bias is partitioned across the  $b_2$  and  $b_3$  coefficients, such that  $b_2$  represents the impact of the prime on false alarm rates, and the sum of  $b_2$  and  $b_3$  represents the impact of the prime on hit rates (as such, the impact of the prime on the non-weighted average endorsement of true and false items is simply:  $\frac{b_2 + (b_2 + b_3)}{2} = b_2 + \frac{1}{2}b_3$ ).

Given these features of this MLLM, the  $b_2$  and  $b_3$  coefficients can be used together to test the hypothesis that the high-anxiety prime produces false memories, in addition to exploring the roles of bias and sensitivity. As aforementioned, the  $b_2$  coefficient represents the simple effect of the anxiety prime on *false alarm rates*. A significantly positive  $b_2$  coefficient would indicate that high state-levels of anxiety cause higher false alarm rates—more numerous false memories. Assuming that the  $b_2$  coefficient is statistically significant (i.e., the attachment prime produces false memories), the  $b_3$  interaction term can be used to elucidate whether attachment anxiety produces false memories by biasing and/or desensitizing people's memories.

Figure 4 illustrates three hypothetical patterns of results with equivalent  $b_2$  coefficients, and varying  $b_3$  coefficients that would indicate the presence of bias effects, sensitivity effects, or both. First, as can be seen in the top-left panel of Figure 4, to the extent that high state-levels of anxiety *bias* memory (i.e., lower the threshold for believing that an item is, in fact, remembered) but do not affect memory sensitivity (i.e., ability to discern true and false information), we should expect a main effect of the anxiety prime, but no interaction between the anxiety prime and item-veracity ( $b_3 \sim 0$ ). Such a finding would indicate that people with high state-levels of anxiety are more likely to experience false memories because anxiety lowers their thresholds for believing that items are, in fact, remembered. This, in turn, causes people to endorse both true and false items at a greater rate than do their peers with lower levels of anxiety.

Second, as depicted in the lower-right panel of Figure 4, to the extent that high state-levels of anxiety reduce memory sensitivity but do not affect bias, we should expect no main effect of the anxiety prime, but should expect a *negative* interaction between the anxiety prime and item-veracity (for this situation to occur, the  $b_3$  coefficient must be roughly twice the absolute magnitude of the  $b_2$  coefficient, but in the opposite direction). Such an interaction would indicate that the anxiety prime interferes with people's abilities to correctly remember the events in the video, which essentially causes them to rely more upon "guesses" about what happened while reconstructing memories.<sup>13</sup> The natural consequence is that both hit rates and false alarm rates will be pressed toward the guessing rate, which would result in a *decrease* in hit rates, and an *increase* in false alarm rates. Such a finding might indicate that individuals with high levels of anxiety are likely to falsely remember events that never occurred simply because their ability to accurately remember events is inhibited; and, as a result, when reconstructing memories, they are "guessing" more about what occurred (and potentially relying more on gist traces than verbatim ones).

Finally, it is possible—and perhaps even likely, based on previous studies (Hudson & Fraley, in preparation)—that the anxiety prime might both increase bias *and* reduce the sensitivity of people's memories. As depicted in the upper-right panel of Figure 4, to the extent that the prime both biases and desensitizes people's memories, we should expect a main effect of the anxiety prime, and a negative interaction between the prime and item-veracity ( $b_3$ ), such that the prime especially promotes increased endorsement of *false* items in particular (for this situation to occur, the  $b_3$  coefficient must be negative, but significantly less than twice the absolute magnitude of the  $b_2$  coefficient). Such a finding would indicate that high state-levels of

---

<sup>13</sup> This is not to say that participants are consciously "guessing" (i.e., randomly choosing answers) the way students guess answers on difficult multiple-choice exams. Rather, the idea is that having inferior memory traces causes the reconstruction process to be "more reconstructive" (i.e., reliant upon guesses rather than solid information).

anxiety inhibit the sensitivity/accuracy of people's memories (potentially forcing them to "guess" more about what happened when reconstructing memories), and also bias them to remember more relationally relevant stimuli (i.e., lower their thresholds for believing that items are, in fact, remembered), causing them to experience false memories. Notably, in this situation, because reduced sensitivity *lowers* hit rates and increased bias *increases* hit rates, it is possible for these effects to mutually cancel and create a situation in which anxiety appears to have no effect on hit rates (e.g., Hudson & Fraley, in preparation).<sup>14</sup>

## Results and Discussion

### Manipulation Checks

After engaging in the visualization experience, participants in the high-anxiety prime and security (low-anxiety) prime groups were asked to rate various aspects of their visualization experience. Participants rated the valence of the recalled memory, as well as the overall valence of the visualization experience *per se* using continuously-scored sliders<sup>15</sup> labeled "very negative" (1) on one end and "very positive" (5) on the other. Participants in the anxiety-prime condition rated the memories that they wrote about and visualized as being more negative ( $M = 2.66$ ) than did participants in the security-prime condition ( $M = 4.05$ ),  $d = -1.19$ , 95% CI [-1.45, -0.94]. Although both groups tended to report that their visualization experience *per se* was somewhat positive (i.e., above the neutral scalar midpoint of 3), anxiety-primed participants rated the visualization experience less positively ( $M = 3.24$ ) than did their security-primed peers ( $M = 3.75$ ),  $d = -0.59$ , 95% CI [-0.89, -0.28].

---

<sup>14</sup> Although not depicted in Figure 4, a positive  $b_3$  coefficient would indicate that the anxiety prime especially boosts people's memories for true events, but also leads them to endorse more false items. This would indicate the prime technically makes people's memories more sensitive, but it also biases them to remember greater numbers of both false and true items.

<sup>15</sup> The sliders were 400 pixels (px) wide. Thus, participants' responses were technically scored in increments of 0.01. Setting the slider as far left as possible would result in a score of 1.00. Shifting the slider 1px right would result in a score of 1.01, and so on. The sliders had guidelines demarcating 5 equal sections (i.e., at 100px, 200px [the scalar midpoint], and 300px), enabling participants to know, for example, precisely where the midpoint was.

Participants also rated the vividness of their visual, auditory, and emotional experience during the visualization process using continuously-scored sliders labeled “not at all vivid” (1) on one end and “extremely vivid” (5) on the other. The anxiety and security prime groups did not differ with respect to the self-reported vividness of their visual (respective  $M_s = 3.54, 3.68$ ;  $d = -0.16$ , 95% CI [-0.47, 0.16]), auditory (respective  $M_s = 3.11, 3.24$ ;  $d = -0.15$ , 95% CI [-0.47, 0.16]), or emotional (respective  $M_s = 3.72, 3.71$ ;  $d = 0.01$ , 95% CI [-0.31, 0.33]) experiences during the visualization.

Taken together, these ratings suggest that both groups engaged in equally vivid visualization experiences. As intended, the participants in the anxiety-prime group reported providing more negative relational memories than did their peers in the security-prime group.

### **Overview of Analyses**

For the sake of clarity, I have divided the analyses for Study 1 into three sections. In the first series of analyses, I attempted to replicate the correlational links between trait-level attachment anxiety and false memories found in previous research (Hudson & Fraley, in preparation). The second section contains analyses that were preregistered in my dissertation proposal and on the Open Science Framework (OSF; <https://osf.io/q5jsb/>). These analyses directly test the hypothesis that priming high levels of attachment anxiety produces false memories. The third and final section contains exploratory analyses—the vast majority of which were discussed in my dissertation proposal, albeit without specific, directional hypotheses.

### **Replication of Previous Correlational Effects**

Previously, Hudson and Fraley (in preparation) found that people with high trait-levels of *partner-specific* (ECR-RS) attachment anxiety were more likely than their less-anxious peers to experience false memories. Before examining the effects of my experimental primes, I first

attempted to directly replicate this correlational finding. This was accomplished by using a MLLM to model the odds of endorsing items as a function of (1) item veracity, (2) trait partner-specific anxiety, (3) the interaction between item veracity and trait partner-specific anxiety, and (4) a random intercept to model within-person dependencies in the data.

As can be seen in Table 1a, I directly replicated Hudson and Fraley's (in preparation) correlational trait-level anxiety effect. There was a significant interaction between trait partner-specific anxiety and item veracity ( $OR_{true \times anxiety} = 0.92$ , 95% CI [0.85, 0.997]), such that as compared with their less anxious peers, persons high in partner-specific attachment anxiety had greater false alarm rates (i.e., endorsement of false items; simple  $OR_{anxiety} = 1.10$ , 95% CI [1.03, 1.18]), but not hit rates (i.e., endorsement of true items; simple  $OR_{anxiety} = 1.01$ , 95% CI [0.94, 1.09]). Translated into model-predicted probabilities, individuals low (1 *SD* below the mean) in partner-specific attachment anxiety had predicted false alarm rates of 31%. The predicted false alarm rate for persons high (1 *SD* above the mean) in partner-specific anxiety was 35%. These false alarm rates are higher than those found in Hudson and Fraley's previous studies (which found false alarm rates of approximately 15-20%) likely because the present studies included a two-day delay between watching the video and completing the memory quiz, whereas participants in Hudson and Fraley's previous studies completed the memory quiz immediately after viewing the video.

As can be seen in Table 1b, using the ECR-S trait general-romantic anxiety scales instead of the ECR-RS partner-specific ones yielded essentially identical parameter estimates, although the two-way interaction between anxiety and item-veracity was not statistically significant. This pattern of findings suggests that attachment anxiety predicts false memories that are attributable to a combination of increased bias and decreased sensitivity (see Figure 4).

In separate models examining avoidance, I replicated Hudson and Fraley's (in preparation) previous findings that avoidance did not predict false alarm rates (simple  $OR_{avoidance} = 0.98$ , 95% CI [0.91, 1.05]) or hit rates (simple  $OR_{avoidance} = 0.96$ , 95% CI [0.89, 1.03]), and there was no interaction between avoidance and item veracity ( $OR_{true \times avoidance} = 0.98$ , 95% CI [0.90, 1.06]).

### Preregistered Primary Analyses

For my next series of analyses, I directly tested the hypothesis that participants primed with high state-levels of attachment anxiety immediately prior to retrieval would endorse greater numbers of false items, as compared with participants in both control groups (security prime, unprimed control) collapsed together. To do so, I used the following MLLM:

$$\ln\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = b_0 + b_1(true)_{ij} + b_2(high\_anxiety\_prime)_j + b_3(high\_anxiety\_prime)_j(true)_{ij} + b_4(trait-anxiety)_j + b_5(trait-avoidance)_j + U_j + \varepsilon_{ij}$$

As can be seen in Table 2a, the high-anxiety prime had an effect on neither false alarm rates (simple  $OR_{anxiety-prime} = 0.99$ , 95% CI [0.85, 1.14]) nor hit rates (simple  $OR_{anxiety-prime} = 1.04$ , 95% CI [0.89, 1.22]), nor was there an interaction between the high-anxiety prime and item veracity ( $OR_{true \times anxiety-prime} = 0.96$ , 95% CI [0.89, 1.25]). Essentially, the high anxiety prime had no main effect on either false or true memories. This may indicate that high levels of state-attachment anxiety do *not* produce false memories *at the point of retrieval*.

### Exploratory Analyses

**Do the anxiety and security primes have different effects?** For my first series of exploratory analyses, I examined the separate effects of all three experimental groups (whereas earlier I had collapsed the security prime and unprimed control groups together). As can be seen in Table 2b, although neither the anxiety nor the security prime had a statistically significant

effect on hit rates or false alarm rates when compared to the control group, it is notable that the primes appeared to have nearly identical effects to each other. Specifically, both primes trended toward *decreasing* false alarm rates (simple  $OR_{anxiety-prime} = 0.93$ , 95% CI [0.79, 1.11]; simple  $OR_{secure-prime} = 0.90$ ; 95% CI [0.76, 1.06]) and *increasing* hit rates (simple  $OR_{anxiety-prime} = 1.06$ , 95% CI [0.88, 1.27]; simple  $OR_{secure-prime} = 1.03$ , 95% CI [0.86, 1.23]). This suggests that, if anything, the primes trended toward *improving* memory during retrieval. This pattern is particularly noteworthy because one would expect a high-anxiety and low-anxiety (i.e., security) prime to have *opposite* effects, not nearly identical ones. Because both primes had nearly identical effects, for simplicity their combined effects (i.e., both prime groups collapsed together compared with the control group) are presented in Table 2c.

**Interactions between primes and trait-attachment.** For my next series of exploratory analyses, I examined whether the anxiety and security primes interacted with people's trait-levels of attachment anxiety to predict endorsement of false and true items. As can be seen in Table 3a, both the anxiety and security primes interacted with trait anxiety in similar ways. As such, to increase statistical power and simplify the analyses, I collapsed both prime groups together and compared them with the control group. The parameter estimates from this analysis are presented in Table 3b. As illustrated in Figure 5, there was a three-way interaction between the primes, item veracity, and trait-anxiety ( $OR = 0.75$ , 95% CI [0.64, 0.89]).

There are two ways to decompose this interaction. The first is to examine the simple slopes of trait-level anxiety predicting true and false item endorsement in the prime and control conditions. For primed participants, there was a simple two-way interaction between item veracity and trait-anxiety (simple  $OR_{true \times anxiety} = 0.85$ , 95% CI [0.77, 0.93]) such that trait-anxiety was related to false alarm rates (simple  $OR_{anxiety} = 1.17$ , 95% CI [1.08, 1.27]) but not hit



rates (simple  $OR_{anxiety} = 0.99$ , 95% CI [0.91, 1.08]). In contrast, in the control group, anxiety was unrelated to endorsement of all items. Specifically, there was no simple two-way interaction between trait-anxiety and item veracity (simple  $OR_{true \times anxiety} = 1.13$ , 95% CI [0.98, 1.31]), and trait-anxiety was unrelated to endorsement of both false items (simple  $OR_{anxiety} = 0.98$ , 95% CI [0.87, 1.12]) and true ones (simple  $OR_{anxiety} = 1.11$ , 95% CI [0.97, 1.28]). This finding is somewhat curious, given that trait anxiety *was* related to false alarm rates in previous studies that did not include a priming manipulation (Hudson & Fraley, in preparation).

The second way to decompose the three-way interaction is to examine the simple effects of the prime for people with various trait-levels of attachment anxiety. For false items, there was a simple two-way interaction between the prime and trait attachment anxiety (simple  $OR_{prime \times anxiety} = 1.19$ , 95% CI [1.02, 1.38]). Specifically, the prime had a statistically significant effect in *reducing* false alarms for persons who were relatively low in trait attachment anxiety (the effect of the prime was statistically significant at  $z_{anxiety} \leq -0.39$ ). As a concrete example, primed participants 1 *SD* below the mean in attachment anxiety had lower false alarm rates (29%) than did their non-primed peers (35%) (simple  $OR_{prime} = 0.76$ , 95% CI [0.62, 0.95]). In contrast, even at the highest trait-level of anxiety observed in the sample ( $z = 3.45$ ), the primes did not statistically significantly increase false alarms (simple  $OR_{prime} = 1.66$ , 95% CI [0.98, 2.82]).

The prime had no effect on endorsement of true items. There was no simple two-way interaction between the primes and trait anxiety (simple  $OR_{prime \times anxiety} = 0.89$ , 95% CI [0.76, 1.05]) and the primes had no statistically significant effect on hit rates at either the lowest observed value of trait anxiety (simple  $OR_{prime} = 1.35$ , 95% CI [0.90, 2.01]) or the highest value of trait anxiety in the sample (simple  $OR_{prime} = 0.70$ , 95% CI [0.40, 1.25]).

To summarize, when people were required to think about any sort of relationship memory—whether security-fostering or anxiety-provoking—highly trait-anxious individuals were likely to experience more false alarms than were their less trait-anxious peers. However, highly trait-anxious individuals were *not* more likely to endorse false items in the control condition. This effect appeared to be primarily driven by the primes *reducing* false alarms for persons who were relatively trait-*secure*. Neither trait-level attachment anxiety nor the primes were related to hit rates (i.e., endorsement of true items) under any circumstance.

How can this pattern of results be explained? At this point, I can only speculate. One potential interpretation is that attachment anxiety does not cause false memories during reconstruction and retrieval processes. The observed interactions between the primes and people's trait-level attachment orientations may have simply been due to sampling error and/or the primes manipulating some unanticipated variable *in addition* to manipulating people's state-level attachment orientations.

However, as I describe in greater depth in the General Discussion, it is also possible that the experimental primes did *not*, in fact, manipulate state levels of attachment anxiety. Rather, it is possible that the manipulation merely forced people to reflect upon their relational histories, and, in doing so, perhaps *activated* or accentuated their existing attachment styles (e.g., Beckes, Simpson, & Erickson, 2010; Fraley & Shaver, 2000; Simpson et al., 2011; Simpson & Rholes, 1998). For example, for highly trait-anxious persons, relationships may be so deeply linked to feelings of insecurity and fears of rejection that thinking about even positive relational episodes opens the associational floodgates and deeply activates intense desires for intimacy and fears of abandonment (i.e., attachment anxiety). Similarly, for highly trait-secure individuals, close relationships may be so deeply associated with feelings of comfort and support, that thinking

about even a negative episode in a relationship activates positive support-seeking and coping mechanisms characteristic of attachment security. Such a phenomenon might explain why both primes—security-fostering and anxiety-provoking—had nearly identical effects that depended on individuals’ trait-level attachment orientations (i.e., the primes reduced false alarms for relatively secure individuals). If it is true that the primes were *not* manipulating people’s state levels of attachment security, but were rather *activating* their *existing* trait attachment orientations, the pattern of results in Study 1 may suggest that *security* improves memories and consequently decreases false alarms at the time of memory reconstruction.

One final peculiarity in Study 1 that deserves comment is the fact that trait-anxiety had a simple association with false alarms only for participants who had been primed, and not for those in the unprimed control group. This is potentially a point of divergence from previous studies, which did not include any prime, yet still found an association between trait-anxiety and false alarms (Hudson & Fraley, in preparation). Sampling error aside, one potential explanation for this discrepancy is that the video stimulus *per se*—used both in the present studies and Hudson and Fraley’s previous work—may have served as a relational prime. If this is the case, then essentially *all* participants in Hudson and Fraley’s previous studies were primed with attachment-related themes immediately prior to completing the memory quiz. In contrast, the unprimed control group in the present study viewed the video, had a two-day break, rated their gist impressions of the characters in the video, and then had a nearly seven-minute break thinking about non-relational themes immediately before completing the memory quiz. As such, the unprimed control group in the present study may represent the only group of participants in any of Hudson and Fraley’s studies thus far that has *not* been primed with relationships immediately prior to completing the memory quiz.

**Positive/negative, gist-consistent/inconsistent items.** As a final exploratory analysis, I examined whether the positive/negative and gist-consistent/gist-inconsistent nature of the items influenced false alarms. Specifically, it might be the case, for example, that participants primed with high state-level attachment anxiety are more likely to falsely remember events that are consistent with the general gist of the story. To test this idea, I modeled the log-transformed odds of endorsing each individual item on the memory test as a function of: (1) whether the item was true/false, (2) whether the item was positive/negative, (3) whether the item was gist-consistent/gist-inconsistent [as rated prior to data collection by myself and two other graduate students], (4) the prime group [anxiety vs. security vs. unprimed control], (4) all two-, three-, and four-way interactions between these factors, and (5) a random intercept for the individual, which modeled and controlled for individuals' overall endorsement rates. There was neither a four-way anxiety-prime  $\times$  true  $\times$  positive  $\times$  gist-consistent interaction (OR = 0.70, 95% CI [0.29, 1.67]) nor a four-way security-prime  $\times$  true  $\times$  positive  $\times$  gist-consistent interaction (OR = 1.08, 95% CI [0.46, 2.55]). This (lack of) interaction is depicted in Figure 6.

Two issues pertaining to this analysis deserve comment. First, the primes did not function as I initially predicted (i.e., anxiety prime increasing false alarms; security prime decreasing false alarms) in any of the eight item groups (true/false  $\times$  positive/negative  $\times$  gist-consistent/inconsistent). The closest such a pattern came to manifesting was in the negative/gist-inconsistent item group. Specifically, for negative/gist-inconsistent items—although neither effect was statistically significant—the anxiety prime trended toward increasing false alarms (OR = 1.09, 95% CI [0.79, 1.49]) and the security prime trended toward decreasing false alarms (OR = 0.87, 95% CI [0.64, 1.20])(even when directly compared to each other, the difference in

false alarm rates between the high-anxiety prime group and the security-prime group was not statistically significant,  $OR = 1.24$ , 95% CI [0.90, 1.71]).

The second issue that deserves comment is that, as can be seen in Figure 6, participants were very unlikely to endorse true items that were negative and gist-inconsistent (but they were not less likely to endorse true items that were *positive* and gist-inconsistent). A post-hoc review of the items in each of these groups suggested that—although the items in each of the eight groups (true/false  $\times$  positive/negative  $\times$  gist-consistent/inconsistent) were written to be roughly equal in terms of specificity—the item groups may have unintentionally differed in other important ways. For example, the four *negative* true/gist-inconsistent items (which were not well-remembered) all pertained to Victoria’s commentary on herself (e.g., “Victoria said that she wasn’t trustworthy or loyal while she dated James”). In contrast, the four *positive* true/gist-inconsistent items (which were remembered at high rates) all pertained to Victoria’s commentary on her relationship with James (e.g., “Victoria said that she and James were very close”). Because the items varied with respect to factors other than their consistency with the gist of the story and their valence, it is difficult to ascertain precisely *why* false alarm rates or hit rates differed across different types of items.

To the extent that future researchers are interested in the effects of gist-consistency and emotional valence on true and false memories, future memory quiz items should be written more carefully to avoid systematic differences between different types of items. This will likely necessitate *creation* of memory stimuli that are amenable to this aim. Specifically, the video used in the present studies is a real account of a true story. Because Victoria paints James and her relationship with him in such a negative light, it is quite difficult to find anything negative she says about James or their relationship that is inconsistent with the general gist of the story.

Consequently, the only negative comments she provides that seem to contradict the overall theme of the story pertained to herself (e.g., she blamed herself for the breakup), making it nearly impossible to balance the different types of items in terms of content. As such, future researchers may need to *create* appropriate memory stimuli, such as stories that are explicitly designed to contain both positive and negative true events that contradict the general gist of the story.

### **Summary of Study 1**

To summarize the findings from Study 1, the high anxiety prime did not have a main effect on false alarm rates. This may indicate that attachment anxiety does not influence formation of false memories during reconstruction and retrieval processes. However, this conclusion must be tempered by the fact that there was an interaction between the primes and people's existing trait-levels of attachment anxiety. Specifically, in the unprimed control condition, trait-anxiety had *no* relationship to false or true memories. In both prime conditions, however, trait-anxiety *was* associated with greater false memories. This effect seemed to be driven wholly by the fact that *secure* individuals who were primed with any type of relational memory experienced *fewer* false memories than their unprimed secure counterparts. This may suggest that the primes were potentially not *manipulating* people's state-levels of attachment security, but were rather having some other unanticipated effect.

### CHAPTER 3: STUDY 2

Whereas Study 1 was designed to test the hypothesis that attachment orientations influence the way that people reconstruct memories, Study 2 was designed to test the hypothesis that attachment orientations can bias the content of the gist traces (i.e., the maintenance path in Figure 3), consequently producing false memories that are manifest upon retrieval. Following procedures similar to Study 1, in an initial session, participants reported their trait-level attachment styles and then watched the video of Victoria describing her relationship and breakup with James. The major difference between Study 1 and Study 2 occurred in the second session. In Study 1, participants first rated their gist impressions of Victoria and James and were *subsequently* primed (to ensure that the prime was as temporally proximal to retrieval as possible). In contrast, in the second session of Study 2, participants were primed *before* reporting their gist impressions of Victoria and James. As such, any direct impacts of the prime would be expected to influence responses on the Time 2 *gist impressions* measure. Furthermore, because participants answered more than 100 questions between the prime and completing the memory test, the prime should not be expected to have a strong *direct* effect on hit rates or false alarm rates. Rather, any effect of the prime on false memories might be expected to be due to the prime biasing people's gist impressions, which subsequently manifests as false memories. As such, this slight shift in procedure enabled me to examine whether state-levels of attachment anxiety can bias gist traces, and subsequently produce false memories.

What might we expect to find? To the extent that attachment anxiety biases the maintenance of gist traces, I would expect to find that participants in the high-anxiety prime group express more negative gist impressions at Time 2, as compared with the control groups. Such a finding would support the idea that high attachment anxiety can bias the maintenance of

gist traces over time, causing highly anxious individuals to remember experiences as having been overall more negative than do their more securely attached peers. In contrast, if attachment anxiety solely biases people's *perceptions* and *encoding* of relationally-relevant stimuli (e.g., Miller & Noiro, 1999), I might expect to find no difference between the high-anxiety prime group and the control groups.

## **Method**

### **Participants**

Recruitment procedures for Study 2 were identical to those in Study 1. Careful records were kept to prevent Study 1 participants from re-participating in Study 2. A total of 265 participants completed the first session in Study 2. Of those, 245 (92%) also completed the second session. Seventy-six percent of the final sample completed Study 2 for course credit, and the remaining 34% were paid \$10 for completing the entire study. The final sample was 70% female, and the racial composition was 59% White, 26% Asian, 8% Black, and 7% Hispanic. Sixty-three percent of the sample indicated that they were single. Thirty-two percent of participants were in a “committed” romantic relationship, and 7% indicated that they were in a “casual” relationship.<sup>16</sup>

### **Measures**

Participants completed measures identical to those in Study 1.

### **Procedure**

As in Study 1, participants scheduled two sessions, exactly two days apart. The procedures in the first session were identical to those in Study 1. Specifically, participants completed the attachment, personality, and demographic measures. They subsequently watched

---

<sup>16</sup> These percentages total to 102% because 2% of participants ( $n = 6$ ) indicated that they were both “single” and “in a casual relationship.”



the 20-minute video of Victoria describing her relationship and breakup with James, and rated their gist impressions of Victoria and James.

The major difference in Study 2 occurred in the second session. In the second session, participants were immediately randomly assigned into 3 groups and received the attachment prime described in Study 1 (anxiety prime, security prime, or unprimed control). They subsequently recompleted the gist-impression measure and surprise memory quiz. In contrast to Study 1, which was concerned with how attachment security influences *reconstruction* of memories, the analyses in Study 2 focused on whether and how *the gist traces themselves* are biased by priming attachment anxiety.

## Results and Discussion

### Manipulation Checks

As in Study 1, participants in the anxiety-prime group rated the memories they wrote about and visualized during the prime as being significantly more negative ( $M = 2.73$ ) than did participants in the security-prime group ( $M = 3.92$ ),  $d = -1.04$ , 95% CI [-1.30, -0.77]. Once again, both groups reported that the visualization experience *per se* leaned toward being a positive one; however, the experience was less positive for anxiety-primed participants ( $M = 3.12$ ) than it was for those primed with security ( $M = 3.68$ ),  $d = -0.60$ , 95% CI [-0.90, -0.31].

Unlike Study 1, individuals in the anxiety-prime condition reported having less vivid visual experiences ( $M = 3.44$ ) than did security-primed participants ( $M = 3.73$ ),  $d = -0.36$ , 95% CI [-0.66, -0.05]. The anxiety- and security-prime groups did not differ, however, on the self-reported vividness of their auditory (respective  $M$ s = 3.15, 3.24;  $d = -0.11$ , 95% CI [-0.42, 0.20]), and emotional (respective  $M$ s = 3.61, 3.73;  $d = -0.14$ , 95% CI [-0.45, 0.17]) experiences during the visualization process.

## Overview of Analyses

As in Study 1, I have divided the analyses for Study 2 into three sections. In the first series of analyses, I attempted to replicate the correlational links between trait-level attachment anxiety and false memories found in previous research (Hudson & Fraley, in preparation). The second section contains analyses that were preregistered in my dissertation proposal and on OSF (<https://osf.io/q5jsb/>). These analyses directly test the hypothesis that priming high levels of attachment anxiety biases gist traces. The third and final section contains exploratory analyses—the vast majority of which were discussed in my dissertation proposal, albeit without specific or directional hypotheses.

## Replication of the Correlational False Memory Effect

As in Study 1, I first attempted to replicate the correlation between trait-level attachment anxiety and false memories found in previous studies (Hudson & Fraley, in preparation). For consistency with Hudson and Fraley's (in preparation) studies, I first examined whether trait-level *partner-specific* attachment anxiety predicted false memories. As can be seen in Table 4a, there was not a statistically significant link between trait partner-specific anxiety and false alarm rates (simple  $OR_{anxiety} = 1.05$ , 95% CI [0.98, 1.11]). Notably, although the odds-ratio linking attachment anxiety to endorsement of false items was not statistically significantly different from 1.00, it was also not statistically significantly different from the estimate of the same association found in Study 1 (Study 1 simple  $OR_{anxiety} = 1.10$ , 95% CI [1.03, 1.18]). That is, the effect estimate from Study 2 ( $OR = 1.05$ ) fell within Study 1's 95% CI ([1.03, 1.18]) and, complementarily, the effect estimate from Study 1 ( $OR = 1.10$ ) fell within Study 2's 95% CI ([0.98, 1.11]). As such, even though Study 2 in isolation does not provide “statistically significant” evidence for a link between partner-specific anxiety and endorsement of false items,

it can be considered a direct replication of Study 1. Therefore, when considered jointly, Studies 1-2 directly replicate a correlational link between trait partner-specific attachment anxiety and endorsement of false items.

With respect to endorsement of true items, although the interaction between item veracity and trait-level attachment anxiety was not statistically significant ( $OR_{true \times anxiety} = 1.03$ , 95% CI [0.96, 1.12]), trait attachment anxiety *was* statistically significantly related to endorsement of true items (simple  $OR_{anxiety} = 1.08$ , 95% CI [1.01, 1.16]). Notably, the estimate of this effect once again fell within the 95% CI from Study 1 (Study 1 simple  $OR_{anxiety} = 1.01$ , 95% CI [0.94, 1.09]) and vice-versa. As such, Studies 1-2 may provide limited evidence that higher levels of trait partner-specific attachment anxiety predict greater endorsement of *both* true *and* false items.

Notably, Studies 1 and 2 *did* statistically significantly differ in the estimate of the interaction between trait-level attachment anxiety and item veracity. Specifically, in Study 1, there was a statistically significant interaction ( $OR_{true \times anxiety} = 0.92$ , 95% CI [0.85, 0.997]), indicating that anxiety had *different* associations with hit rates and false alarm rates (more specifically, anxiety predicted greater false alarms, and was unrelated to hit rates). In contrast, the interaction in Study 2 was not statistically significantly different from 1.00 ( $OR_{true \times anxiety} = 1.03$ , 95% CI [0.96, 1.12]), but it *did* statistically significantly differ from the odds ratio found in Study 1. This lack of interaction in Study 2 is a point of divergence from both Study 1 and previous research (Hudson & Fraley, in preparation), and may therefore be attributable to sampling error.

Using general-romantic (ECR-S) attachment anxiety measures instead of the partner-specific measures yielded similar results. As can be seen in Table 4b (and by comparing it with Table 1b), the odds-ratio link between general-romantic anxiety and endorsement of false items

was once again not statistically significantly different from 1.00 (simple  $OR_{anxiety} = 1.04$ , 95% CI [0.98, 1.11]), but it was also not statistically significantly different from the estimate found in Study 1 (Study 1 simple  $OR_{anxiety} = 1.10$ , 95% CI [1.03, 1.18]), and vice-versa. Notably, using the ECR-S measure, trait-anxiety was *not* statistically significantly related to endorsement of true items in Study 2 (simple  $OR_{anxiety} = 1.04$ , 95% CI [0.98, 1.12]).

In summary, Study 1 provided a clear direct replication of previous research (Hudson & Fraley, in preparation): trait-level partner-specific anxiety was statistically significantly related to false alarm rates, but was unrelated to hit rates. Study 2 in isolation provided less clear evidence, but can be viewed as a direct replication of the link between partner-specific anxiety and false alarm rates. In contrast, Study 2 diverged from both Study 1 and previous research in its findings that partner-specific anxiety was also related to hit rates. Finally, using the ECR-S general-romantic subscales (instead of ECR-RS partner-specific ones) generally yielded similar patterns of results in both Studies 1-2, albeit with generally smaller effect sizes and/or larger standard errors. As a consequence, although the ECR-S effect estimates were never statistically significantly different from those found using the ECR-RS scales, the confidence intervals for the odds ratios frequently included 1.00 and, as such, were not statistically significant *per se*.

### **Does Attachment Anxiety Bias People's Gist Impressions?**

My primary analysis for Study 2 examined how participants' gist-impressions at Time 2 varied as a function of the attachment anxiety prime and security prime, controlling for their initial impressions at Time 1. To do so, the following ordinary least-squares regression was used:

$$(Gist_{T2}) = b_0 + b_1(high\_anxiety\_prime) + b_2(security\_prime) + b_3(anxiety) + b_4(avoidance) + b_5(Gist_{T1}) + \varepsilon$$

The gist impression and trait-attachment variables were standardized before being entered into the model, whereas the anxiety prime and security prime variables were dummy coded with the unprimed control group as the reference group. As such, the coefficients for the anxiety and security primes are similar (albeit not necessarily identical) to  $d$ s—the standardized difference between primed participants and participants *in the unprimed control group*. The coefficients for trait-anxiety, trait-avoidance, and Time 1 gist impressions are similar (albeit not necessarily identical) to  $\beta$ s—the standardized associations between the predictors and outcome. To remind readers of these interpretational nuances, I use the notation  $b_d$  and  $b_\beta$  to refer to  $d$ -like and  $\beta$ -like effects.

As can be seen in Table 5, as compared with the unprimed control group, neither prime had an effect on people's gist impressions at Time 2, controlling for their initial Time 1 impressions, all  $|b_d/s| \leq 0.11$  (notably, if the model is reconfigured such that the security prime group is the reference group, participants primed with high anxiety also did not differ from those primed with security,  $b_d = -0.14$ , 95% CI [-0.33, 0.04]). This may be partially due to the fact that people's impressions were quite stable over time for Victoria ( $b_\beta = 0.84$ ), James ( $b_\beta = 0.83$ ), and overall ( $b_\beta = 0.79$ ). Taken together, these findings suggest that the prime did *not* influence people's overall gist impressions, nor their individual impressions of Victoria and James. This may suggest that high levels of attachment anxiety do not bias people's gist traces over time.

### Exploratory Analyses

**Interactions between the primes and trait-attachment.** Next, I examined whether the attachment primes interacted with people's trait attachment styles to predict their gist impressions at Time 2, controlling for their Time 1 impressions. As can be seen in Table 6, *both* primes interacted with trait attachment anxiety in similar ways to predict overall gist impressions

( $b_{anxiety-prime \times anxiety} = 0.27$ , 95% CI [0.08, 0.46];  $b_{security-prime \times anxiety} = 0.24$ , 95% CI [0.06, 0.42]), and to a lesser degree, impressions of James ( $b_{anxiety-prime \times anxiety} = 0.16$ , 95% CI [-0.01, 0.33];  $b_{security-prime \times anxiety} = 0.17$ , 95% CI [0.004, 0.33]) and Victoria ( $b_{anxiety-prime \times anxiety} = 0.15$ , 95% CI [-0.01, 0.32];  $b_{security-prime \times anxiety} = 0.15$ , 95% CI [-0.01, 0.31]).

This interaction for overall gist impressions is depicted in Figure 7. There are two ways to decompose this interaction. First, the simple slopes for trait-anxiety can be computed within each of the three prime groups. Trait-anxiety was negatively related to gist impressions in the unprimed control group (simple  $b_\beta$ s: overall  $b_\beta = -0.20$ , 95% CI [-0.33, -0.08]; James  $b_\beta = -0.16$ , 95% CI [-0.27, -0.04]; Victoria  $b_\beta = -0.10$ , 95% CI [-0.21, 0.02]). In contrast, trait-anxiety was unrelated to gist impressions in *both* the high-anxiety prime group (simple  $b_\beta$ s: overall  $b_\beta = 0.06$ , 95% CI [-0.07, 0.20]; James  $b_\beta = 0.00$ , 95% CI [-0.13, 0.13]; Victoria  $b_\beta = 0.06$ , 95% CI [-0.07, 0.18]) *and* in the security-prime group (simple  $b_\beta$ s: overall  $b = 0.03$ , 95% CI [-0.10, 0.16]; James  $b_\beta = 0.01$ , 95% CI [-0.11, 0.13]; Victoria  $b_\beta = 0.05$ , 95% CI [-0.07, 0.17]).

The second way to decompose this interaction is to examine the simple effects of the primes at different levels of trait-attachment anxiety. First, on the secure end of the spectrum, the high anxiety prime was statistically significantly related to *more negative* overall gist impressions for people 0.81 or more *SDs below* the mean in trait-attachment anxiety. For example, for persons 1 *SD* below the mean in trait-anxiety, the simple effect of the anxiety prime was  $b_d = -0.29$ , 95% CI [-0.56, -0.03]. The *security* prime also statistically significantly caused the most secure individuals in the sample ( $z_{anxiety} \leq 2.51$  [the lowest observed value of anxiety in the sample was  $z = -2.52$ ]) to rate their gist impressions more negatively. Finally, on the anxious end of the spectrum, the high anxiety prime caused people 1.13 *SDs* or more above the mean in trait-attachment anxiety to report *more positive* gist impressions than their unprimed peers.

Similarly, the security prime statistically significantly caused moderately trait-anxious individuals ( $z_{anxiety} \geq 0.30$ ) to provide more positive overall gist impressions.

In summary, in the control condition, highly trait-anxious individuals tended to report more negative overall gist impressions than did their less anxious peers. *Both* primes—anxiety-provoking *and* security-fostering—erased this association between trait-anxiety and gist impressions by simultaneously causing relatively trait-secure individuals to report *more negative* gist impressions and causing relatively trait-anxious individuals to report *more positive* gist impressions, as compared with their respective unprimed peers.

**Links between gist impression and false memories.** In my next series of analyses, I examined whether and how people's gist impressions were associated with their endorsement of true and false items on the surprise memory test. There was a statistically significant interaction between people's Time 2 overall gist impressions and item veracity ( $OR = 0.91$ , 95% CI [0.84, 0.98]), such that overall gist impressions were not statistically significantly related to false alarms (simple  $OR_{gist} = 0.99$ , 95% CI [0.92, 1.05]). In contrast, people with more positive overall gist impressions tended to have *lower* hit rates—they endorsed fewer *true* items (simple  $OR_{gist} = 0.89$ , 95% CI [0.83, 0.96]). Thus, people who had relatively positive impressions of the characters in the video were less likely to correctly remember events that had occurred in the video, as compared with their peers with relatively negative impressions. This may be because the video described a tumultuous relationship and turbulent breakup; as such, more positive gist impressions may not necessarily reflect an accurate representation of the source material.

**Did the manipulation create false memories?** As can be seen in Table 7a-7c, neither the high-anxiety prime nor the security prime had any effect on endorsement of false or true items. Unlike Study 1, in which the primes non-significantly trended toward *improving* memory

and *reducing* false alarm, in Study 2, the primes non-significantly trended toward *increasing* false alarms by biasing and desensitizing participants' memories. Also contrasting with Study 1, neither prime interacted with trait-attachment anxiety to predict endorsement of any type of item, whether false or true (see Tables 8a-8b).

These non-statistically significant findings are not particularly surprising for at least two reasons. First, although the primes *did* interact with trait-level attachment anxiety to alter people's gist impressions, gist impressions were unrelated to endorsement of false items. Furthermore, given that the prime was more temporally distant from the memory quiz than it was in Study 1 (in Study 2, participants answered more than 100 questions between the prime and memory quiz), we should not necessarily expect it to have strong direct effects on retrieval processes.

### **Summary**

To summarize the findings from Study 2, the high anxiety prime did not have a main effect on people's gist impressions of Victoria and James. This may indicate that high levels of attachment anxiety do not bias people's gist traces—and consequently, attachment anxiety does not produce false memories during maintenance processes. As in Study 1, there was, however, an interaction between the attachment primes and people's existing trait-attachment anxiety. Specifically, the primes seemed to cause relatively trait-secure individuals to have *more negative* gist impressions. In contrast, both primes caused relatively trait-anxious individuals to have *more positive* gist impressions. This interaction may indicate, as in Study 1, that the primes were not actually *manipulating* people's state-levels of attachment anxiety.

Finally, people's gist impressions were unrelated to false alarms. Furthermore, the primes did not have a main effect on false alarms, nor did the primes interact with trait-



attachment styles to predict false alarms as they did in Study 1. This may be attributable to the fact that, in Study 1, the primes *immediately* preceded the memory quiz, whereas in Study 2, the primes were separated from the memory quiz by approximately 100 questions.

## CHAPTER 4: GENERAL DISCUSSION

Previous research has found that people with relatively high trait-levels of attachment anxiety are likely to experience false memories during recognition tasks (Hudson & Fraley, in preparation). The present studies were designed to test whether attachment anxiety *causes* false memories—and specifically whether it does so during retrieval or maintenance processes. This was accomplished by experimentally priming some participants with high or low attachment anxiety—in attempt to manipulate their state-levels of attachment anxiety (Baldwin et al., 1996; Carnelley & Rowe, 2010; Gillath et al., 2006, 2008)—immediately prior to retrieval (Study 1), or during maintenance (Study 2). Despite the fact that the correlational link between trait-anxiety and false memories was replicated in both Studies 1-2, across both studies, the experimental attachment anxiety primes did not have any main effect on true or false memories.

The results from these studies have several possible interpretations. First, it may be the case that attachment anxiety simply does not cause false memories *during maintenance or retrieval processes*. Nevertheless, it remains possible that attachment anxiety might, in fact, cause false memories—but may do so at the time memories are *encoded* (e.g., the effects of attachment avoidance on errors of *omission* are thought to occur during encoding processes; Edelstein, 2006; Fraley & Brumbaugh, 2007; Miller & Noiro, 1999). This possibility remains to be tested in future studies.

Of course, it is also possible that future research may find that priming attachment anxiety prior to encoding also fails to produce subsequent false memories. Such a finding might potentially suggest that attachment anxiety does *not* cause false memories during *any* stage of memory. This may indicate that the repeatedly-observed correlational link between attachment

anxiety and errors of omission is the result of other causal processes (e.g., reverse causality, third variables).

Finally, it may be the case that asking participants to reflect upon relational memories that exemplify attachment anxiety or security—as was done in the present studies—does not actually *manipulate* participants' state-level attachment orientations, but rather has somewhat different effects than were anticipated by previous researchers (Baldwin et al., 1996; Carnelley & Rowe, 2010; Gillath et al., 2008). Stated differently, it is possible that attachment primes lack construct validity in terms of manipulating individuals' state-level attachment orientations. If this is, in fact, the case, then the present studies provide little information about the causal impact of attachment anxiety on false memories. In the sections that follow, I will review the findings from Studies 1-2 and discuss each of these interpretative possibilities in greater depth.

### **Does Attachment Anxiety Cause False Memories during Retrieval?**

Study 1 was designed to test the idea that attachment anxiety causes false memories at the point of memory reconstruction and retrieval. Specifically, people's intrapersonal and external circumstances can affect which memory traces are available and active during memory retrieval (Dell, 1986). As such, it is possible that highly anxious individuals, who are chronically preoccupied with relational concerns (e.g., Fraley & Shaver, 2000; Mikulincer & Shaver, 2007) might experience source memory confusion (Johnson et al., 1993) during memory reconstruction processes, and falsely believe that their chronically activated relational concerns are relevant to the memories being retrieved (e.g., Straube, 2012).

To test this idea, participants in Study 1 watched a video of a woman describing a tumultuous relationship and breakup (Hudson & Fraley, in preparation). After a two-day delay, participants were primed (Baldwin et al., 1996; Carnelley & Rowe, 2010; Gillath et al., 2006,

2008) with [1] high attachment anxiety, [2] attachment security (i.e., low attachment anxiety) or [3] received no prime. Immediately after the prime, participants completed a surprise recognition memory quiz and were asked to identify whether 54 events were described in the video or not. Because the manipulation occurred *after* encoding and maintenance processes and immediately prior to retrieval, any differences in false memories between the groups are attributable to attachment anxiety influencing retrieval processes.

There was, however, no main effect of either the high-anxiety or security (low-anxiety) primes on false alarm rates or hit rates during the memory quiz. In contrast, *both* the anxiety and security prime interacted with participants' existing trait-levels of attachment anxiety to predict performance on the memory quiz. And curiously, both primes interacted with trait-anxiety *in the same way*. Specifically, in the control group, trait-attachment anxiety was unrelated to false memories. However, in *both* prime groups, higher trait-levels of attachment anxiety predicted greater false memories. Simple effect analyses revealed that this was primarily driven by the primes *reducing* false alarms for individuals who were relatively trait-*secure*—and the primes had no effect on individuals who were relatively high in trait attachment anxiety.

This pattern of results may suggest that attachment anxiety does not cause false memories during reconstruction and retrieval processes. However, the fact that priming opposite ends of the attachment anxiety continuum had identical effects calls into question the construct validity of the primes as a *manipulation* of people's state-level attachment orientations. As I discuss in greater depth below, one possible explanation for this pattern of results is that—rather than priming specific levels of attachment anxiety—our primes may have served to *activate people's existing* attachment styles (e.g., Beckes et al., 2010; Simpson et al., 2011). Specifically, the defining feature of attachment anxiety is the propensity to (1) fear that attachment figures might

not be available, and (2) more readily initiate behavioral strategies designed to increase emotional and physical proximity with close others (Fraley & Shaver, 2000; Hazan & Shaver, 1987; Mikulincer & Shaver, 2007). As such, merely thinking about any type of previous relationship—even positive relational episodes—might be sufficient to remind highly anxious individuals about their relational fears and activate anxiety-related goals. Similarly, secure individuals tend to associate close relationships with comfort, safety, and support (Hazan & Shaver, 1987; Mikulincer & Shaver, 2007). As a consequence, thinking about close relationships—even negative episodes therein—may activate secure individuals’ propensity to seek support in positive ways and effectively use others as a means to gain a sense of comfort and safety.

If attachment primes do, in fact, merely *activate* people’s existing attachment styles, then Study 1 suggests that activating *security* at the time of retrieval may sharpen people’s memories by reducing bias and fostering sensitivity. Specifically, the only causal effect of the primes in Study 1 was to *reduce* false alarms for relatively trait-secure individuals. Therefore, to the extent that the primes operate by activating existing attachment styles, it follows that activating security during retrieval reduces false alarms.

One complexity inherent to this explanation is that previous studies have found a relationship between attachment anxiety and false alarm rates among unprimed participants (Hudson & Fraley, in preparation), whereas in the current study, such a link was found only among *primed* participants. One potential resolution to this apparent contradiction is that in Hudson and Fraley’s previous studies, participants always viewed the video of a woman describing a tumultuous relationship and breakup, *and then immediately* took the memory quiz, whereas in the present studies there was a two-day delay between these events. Consequently, it

may be the case that the video *per se* acted as a prime, activating relational concepts in participants' minds. If this is true, then in effect, *all* of Hudson and Fraley's previous participants were, in fact, primed with relational themes immediately prior to completing the memory quiz. And as a consequence, the *only* group of participants in any of their studies to receive *no* prime immediately prior to the video would be the control group in the present study, who reflected on an instrumental song and an abstract painting for the seven minutes immediately preceding the memory quiz.

In summary, in Study 1, I found that priming high and low levels of attachment anxiety had no main effect on true or false memory. There was an interaction between the primes and participants' trait-level attachment orientations, such that requiring relatively trait-secure individuals to think about a relational memory—whether positive or negative—immediately prior to retrieval *reduced* false memories. Because the construct validity of the primes used is questionable, the meaning of this finding is unclear.

### **Does Attachment Anxiety Bias Maintenance of Gist Traces?**

Study 2 was designed to test the idea that high levels of attachment anxiety might bias people's memory traces during maintenance processes, potentially producing a downstream impact on false memories. Specifically, previous research indicates that when new information is encoded into memory, it can alter or corrupt existing memory traces (e.g., Loftus & Palmer, 1974; Straube, 2012; Wright & Loftus, 1998). Furthermore, a growing body of literature has suggested that insecurely attached individuals' assessments of the overall valence of interpersonal experiences becomes increasingly negative over time (e.g., Simpson et al., 2009). It may therefore be the case that highly anxious individuals encode and process new information in such a way that false details are introduced into existing memories.

To test this idea, in Study 2, participants viewed a video of a woman describing a breakup and rated their gist impressions of the characters described in the video. In a separate session two days later, participants immediately received either (1) a high anxiety prime, (2) a security (low anxiety) prime, or (3) no prime. Subsequently, all participants were asked to rerate their gist impressions of the characters in the video before completing a surprise memory quiz. Similar to the processes observed in Loftus and Palmer's (1974) famous study, to the extent that attachment anxiety influences maintenance processes, I expected that making feelings of insecurity salient to participants before asking them to recall their general gist impressions of the video would (1) cause their gist impressions to become more negative, and that (2) this would have a downstream impact on false memories during the memory quiz.

As in Study 1, neither the high-anxiety prime nor the security prime had a main effect on the valence of participants' gist impressions. Similarly, neither prime had any main effect on endorsement of false or true items during the memory quiz. This may suggest that attachment anxiety does not influence maintenance of gist traces over time.

However—as in Study 1—both primes interacted with participants' existing trait-levels of attachment anxiety to influence gist impressions. Also mirroring Study 1, the primes interacted with trait-anxiety *in the same way*. Specifically, in the unprimed control group, trait attachment anxiety was related to more negative gist impressions of the characters in the video, controlling for their earlier gist impressions. This seems to be consistent with previous research suggesting that individuals high in trait attachment anxiety rate interpersonal experiences more negatively after a delay, as compared with their immediate ratings (e.g., Dykas et al., 2012; Gentzler & Kerns, 2006; Simpson et al., 2009).

In contrast, in *both* prime groups, the negative association between trait attachment anxiety and gist impressions was *entirely* erased (and trended non-significantly toward a positive association). Simple effect analyses revealed that this occurred because the primes caused highly trait-anxious individuals to report *more positive* gist impressions than their unprimed highly trait-anxious peers. And perhaps more surprisingly, the primes also caused relatively trait-secure individuals (i.e., those relatively low in trait-anxiety) to report *more negative* gist impressions than their unprimed, relatively trait-secure peers.

This curious pattern of results might once again suggest that, rather than manipulating participants' state levels of attachment anxiety, the primes actually served to *activate* people's existing trait-level attachment orientations. Specifically, reflecting on one's own prior relationships might trigger social comparison processes (Festinger, 1954). In comparison to relatively secure individuals' generally close and comfortable relational histories (Hazan & Shaver, 1987), Victoria and James's story might have seemed particularly dysfunctional, leading to more negative gist impressions. Similarly, anxious individuals report more negative relational experiences than do their more secure counterparts (e.g., Sutin & Gillath, 2009). As such, reflecting on their relational histories may have made Victoria and James's story seem comparatively less negative—leading to more positive gist impressions.

Nevertheless, neither prime in Study 2 had an effect—main or interactive—on subsequent true or false memories. This may be due to the fact that prime was separated from the memory quiz by the gist impressions measure, which contained 100 questions (for an average participant, who takes 3-4 seconds to answer a single question, this translates into five to seven minutes). As a result, any effect of the prime may have been substantially reduced, to the point where its impacts were no longer detectable. Furthermore, although the prime *did* interact with



trait-anxiety to predict participants' gist impressions, gist impressions were unrelated to false alarms. Consequently, it was not possible for the manipulation to have an indirect effect on false memories via gist impressions.

In summary, in Study 2, I found that priming high and low levels of attachment anxiety had no impact on participants' gist impressions or performance on the memory quiz. There was an interaction between the primes and participants' trait-level attachment anxiety in predicting gist impressions. However, this interaction did not predict downstream performance on the memory test. As in Study 1, the pattern of results may suggest that attachment primes are not a construct-valid *manipulation* of attachment orientations, rendering the meaning of these findings unclear.

### **Implications for Understanding False Memories**

Neither Study 1 nor Study 2 produced the expected pattern of results. Priming high attachment anxiety during maintenance or retrieval processes had no main effect on false or true memories. One potential interpretation of these data is that attachment anxiety does *not* cause false memories—at least during memory maintenance or reconstruction and retrieval. However, the present studies did not explore the impact of priming attachment anxiety *prior to encoding*. Therefore, it remains possible that high levels of attachment anxiety do, in fact, cause people to experience false memories, but that this phenomenon operates by introducing false memories at the point of encoding. This possibility can be tested in future research by priming high- and low-state-levels of attachment anxiety *prior* to viewing the source stimuli. To the extent that attachment anxiety creates false memories during encoding processes, we would expect participants primed with high levels of attachment anxiety prior to watching the video to report greater numbers of false memories during the subsequent memory quiz. If such a pattern of

results were found, it would suggest, in conjunction with the present Studies 1-2, that attachment anxiety produces false memories specifically during encoding—and not during maintenance or retrieval processes. Such a finding would dovetail nicely with previous research suggesting that attachment likely exerts its impact on memory for *true* events at the point of encoding (e.g., Edelstein, 2006; Fraley & Brumbaugh, 2007; Miller & Noirot, 1999).

However, it is also possible that future studies may find no effect of priming attachment anxiety prior to encoding. As described in greater depth below, this may reflect methodological inadequacies with respect to current priming procedures. Alternatively, it may simply be the case that attachment anxiety does not, in fact, cause people to experience greater numbers of false memories. It may be the case that the repeatedly observed correlation between attachment anxiety and false alarms during recognition tests—both in previous research (Hudson & Fraley, in preparation) and in the present studies—is due to reverse causality or unspecified third variables.

With respect to reverse causality, it may be the case that individuals who are prone to experiencing false memories have unreliable mental records of past experiences in which they received care. Systematic errors in remembering relational events (e.g., Dykas et al., 2010, 2012; Simpson et al., 2009; Woodhouse & Gelso, 2008) may cause these individuals to believe—based on false information—that others are unreliable or inconsistent in providing for the self's needs, perhaps because the self is unlovable or unworthy of love. These types of beliefs may cause individuals to experience higher levels of attachment anxiety (Hazan & Shaver, 1987). As such, attachment anxiety may be the *result* of individuals systematically misremembering their relational histories, rather than an antecedent of it.

Notably, this possibility is quite difficult to ethically or pragmatically test using randomized experimental designs. Specifically, to the extent that fallacious chronologies of one's relational past can produce attachment anxiety, we would expect that those memory errors must be systemic. Given that people have hierarchical models of attachment relationships (Collins et al., 2004; Fraley, Heffernan, et al., 2011; Sibley & Overall, 2008, 2010), it is unlikely that misremembering isolated experiences within a single relationship will dramatically affect people's overall representations of close relationships in general (e.g., Cozzarelli, Hoekstra, & Bylsma, 2000; Cozzarelli, Karafa, Collins, & Tagler, 2003). Rather, one would expect that increases in generalized attachment anxiety must be the result of generally misremembering events across a wide array of different close relationships. Therefore, in order to properly experimentally test the notion that false memories cause attachment anxiety, individuals' *propensities* to falsely remember relational events would need to be manipulated.

It might be potentially feasible to effect such a manipulation by repeatedly implanting false relational memories over an extended period of time and measuring the resultant impact on attachment anxiety (for discussions of changing people's attachment styles through repeated manipulations, see Carnelley & Rowe, 2007; Gillath et al., 2008). However, the ethics of such an "intervention"—and its predicted consequence of increasing people's attachment anxiety—are highly dubious at best. As such, it may be the case that the best feasible way to test a causal link between false memories and attachment anxiety is through correlational longitudinal designs. Specifically, internal validity is not an "either/or" phenomenon—but rather it varies on a spectrum. Although randomized experiments maximize internal validity, well-designed longitudinal studies can offer information on causality above and beyond single-assessment surveys. For example, if increases in false memories predict *subsequent* changes in attachment

anxiety (but not vice versa) in an extended longitudinal design, such a finding would suggest that propensity to experience false memories precedes attachment anxiety. This would indicate that false memories either cause attachment anxiety or that—at the very least—the propensity to experience false memories covaries closely with whatever third variable does, in fact, cause increases in attachment anxiety.

### **Did the Present Studies Actually Manipulate Attachment Anxiety?**

Although—as discussed above—one potential interpretation of the present data is that attachment anxiety does not cause false memories during maintenance or retrieval, several persistent peculiarities pertaining to the priming manipulations suggest that such conclusions may be premature. Specifically, in *both* Studies 1 and 2, the high-anxiety prime and the security (low-anxiety) prime had nearly identical effects. Similarly, in *both* studies, the anxiety and security prime had nearly identical interactions with participants' existing trait-levels of attachment anxiety.

Because attachment anxiety is a dimensional construct (Fraley et al., 2015), one would expect—to the extent that anxiety has a linear relationship with an outcome—that priming high vs. low attachment anxiety would have *opposite* effects, when compared to an unprimed control group. The fact that a high anxiety prime and low anxiety prime had nearly identical effects seems to suggest either that (1) attachment anxiety has a curvilinear relationship with false alarms during recognition tasks, or that (2) the attachment primes lack construct validity as *manipulations* of attachment anxiety. The former can be tested in both Hudson and Fraley's (in preparation) original demonstration of the anxiety/false memory effect, and in the present Study 1, which most clearly replicated Hudson and Fraley's prior effect. There was no curvilinear effect of trait partner-specific anxiety on false memories in either Hudson and Fraley's original

data demonstrating the effect (anxiety<sup>2</sup> OR = 0.99, 95% CI [0.91, 1.08]) or in the data from Study 1 (anxiety<sup>2</sup> OR = 0.94, 95% CI [0.88, 1.01]). This suggests that attachment anxiety does not relate curvilinearly with false alarms—and so we should not expect manipulations that induce high and low attachment anxiety to have identical effects.

Therefore, it is possible that the attachment primes did not function to *manipulate* people's attachment styles. Indeed, although there appears to be widespread consensus on the notion that attachment styles can be temporarily manipulated using priming procedures (e.g., Baldwin et al., 1996; Gillath et al., 2008, 2010; Luke et al., 2012; Mikulincer et al., 2005; Mikulincer, Shaver, Sahdra, & Bar-On, 2013; Park, 2007; Rom & Mikulincer, 2003; Rowe & Carnelley, 2003), a closer examination of the empirical evidence for attachment priming suggests that this conclusion may not be merited.

I do not wish to be unfairly critical of previous research. So, it is important to note that a great number of studies have consistently documented benefits of priming attachment security. For example, a wide array of research has suggested that, in comparison to unprimed control groups (and occasionally groups primed with generalized positive affect), participants primed with attachment security are more empathetic (Mikulincer, Gillath, et al., 2001), authentic (Gillath et al., 2010), responsive (Mikulincer et al., 2013), generous (McClure et al., 2013), creative (Mikulincer, Shaver, & Rom, 2011), benevolent (Mikulincer et al., 2003), altruistic (Mikulincer et al., 2005), and positive toward both outgroup members (Boag & Carnelley, 2012; Mikulincer & Shaver, 2001) and even unfamiliar symbols (Mikulincer, Hirschberger, Nachmias, & Gillath, 2001). As compared with unprimed controls, security primes appear to absolve the negative effects of insecurities about one's appearance (Park, 2007) or self-worth (Mikulincer, Shaver, Bar-On, & Sahdra, 2014), and security primes have even been shown to override the

negative effects of cognitive depletion (Mikulincer et al., 2013) or mortality salience primes (Weise et al., 2008). Perhaps most convincingly, repeatedly priming participants with attachment security causes them to report more positive self-views and relational expectations, as well as lessened self-reported trait-level attachment anxiety over time (Carnelley & Rowe, 2007).

These studies might initially lead one to conclude that priming attachment security causes people to “behave more securely.” However, the fundamental problem with this conclusion is that the vast majority of these studies lacked appropriate comparison groups to rule out alternative explanations. Because *low* attachment security was not primed, it is unclear whether the positive effects of the primes were due to elevated attachment security *per se*, or whether such effects are attributable to merely priming relationships in general, close relationships (irrespective of their valence), or attachment relationships (irrespective of security or valence); causing participants to reflect on love (e.g., Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008), or their experiences (King, 2002); enhancing positive affect; or even altering some other unanticipated construct. Although some studies have included control groups primed with generalized positive affect and/or non-attachment relationships in attempt to rule out some of these alternative explanations, there is little consensus in the results and theoretical framework. For example, in some studies, leading researchers have found that security primes have similar effects to priming positive affect, joy, or feelings of closeness (e.g., Mikulincer, Hirschberger, et al., 2001; Mikulincer et al., 2005); in other studies they have found that attachment security *per se* is unique or special, and has impacts beyond variables like positive affect (e.g., Mikulincer et al., 2003; Mikulincer & Shaver, 2001). As such, based on these studies alone, it is unclear whether security primes are truly *manipulating* attachment security, or whether they actually serve to operationalize some other variable with beneficial effects (or perhaps both).

One way to partially address this limitation is to prime multiple points along the security-insecurity continua (e.g., low anxiety, high anxiety; low avoidance, high avoidance). Such a design allows researchers to test for differences that should exist between, for example, highly anxious and highly secure individuals—all while holding constant across conditions several potentially important factors (e.g., reflection on attachment themes and close relationships). To this end, several studies have primed both security and insecurity (most frequently attachment anxiety). These studies have produced mixed findings. The primes sometimes appear to function as would be expected were they *manipulating* attachment security. For example, in comparison to insecure primes, security primes have been shown to increase felt security and self-reported energy (Luke et al., 2012), reduce perceptions of inequity in relationship vignettes (Grau & Doll, 2003), increase empathy and decrease personal distress (Mikulincer, Gillath, et al., 2001), increase the number of positive words people use in free-response essays (Carnelley & Rowe, 2010), and potentially reduce lying in certain contexts (Chugh, Kern, Zhu, & Lee, 2014; Gillath et al., 2010). However, other studies have found no main effect of different types of primes (e.g., Gillath, Giesbrecht, & Shaver, 2009), or that anxiety and security primes function similarly when compared to avoidance primes (e.g., Rowe & Carnelley, 2003 found that both primes increased memory for positive attachment-related words). Furthermore, some studies have even found that the primes produced effects that were directly *opposite* what should be expected theoretically if people's attachment styles were truly being manipulated. For example, in various studies, priming high levels of attachment anxiety as opposed to security increased accessibility of *agency*-related themes (Bartz & Lydon, 2004), and promoted desire for *distance* from others (Birnbaum, Simpson, Weisberg, Barnea, & Assulin-Simhon, 2012). This seems to be precisely the opposite of what should be expected were the primes *manipulating* attachment

anxiety; a manipulation that *increases* attachment anxiety should theoretically *increase* desires for *dependence* and *intimacy* (Hazan & Shaver, 1987; Mikulincer & Shaver, 2007).

Nevertheless, the vast majority of these studies that primed both security and insecurity lacked an unprimed control group. As a consequence, it is unclear whether security and anxiety primes, for example, have *opposite* effects when compared to unprimed control groups (as they theoretically should). As an example, the finding that persons primed with attachment security reported higher felt-security than did individuals primed with attachment anxiety (Luke et al., 2012) has a completely different meaning depending on how the two primed groups might have related to an unprimed control group. If, in comparison to an unprimed control group, the anxiety prime *reduced* felt security and the security prime *increased* felt security, this would support the notion that attachment styles were truly being manipulated. If, however, *both* the security prime *and* the anxiety prime *increased* felt security as compared with an unprimed control, this would clearly suggest that the primes were not functioning as intended (e.g., why would an insecurity prime *increase* felt security?). Rather, it would suggest that both primes are beneficial, but the security prime is simply *more beneficial than* the anxiety prime. To be able to differentiate between these possibilities and fully understand the construct validity of attachment primes as a method to *manipulate* attachment styles, it is necessary to explicitly compare (1) a group primed with security, (2) a group primed with insecurity and/or anxiety, and (3) an unprimed control group.

To find a reasonably comprehensive set of articles discussing attachment priming, I searched PsycINFO for all peer-reviewed English articles containing in any field the words “attachment,” “prime” or “priming,” and any of the words typically used to refer to the dimensions of attachment (“anxiety” or “avoidance” or “secure” or “security”). This search



returned 46 relevant articles in which attachment styles were primed.<sup>17</sup> Among these articles, many of which contained multiple studies, only *five* studies included (1) a group primed with attachment security, (2) a group primed with some form of attachment insecurity [including any sort of negative relationship memory], and (3) an unprimed control group that was not asked to reflect on their relationships [to maximize inclusiveness, non-relational affective primes, e.g., happiness, were counted as unprimed control groups]. Of these studies, two found no main effect between any prime group (Bowles & Meyer, 2008; Collins & Gillath, 2012). An additional two studies found that anxiety and security primes had similar positive effects, as compared with an unprimed control group (Gillath et al., 2010; Rowe et al., 2012). Sutin and Gillath's (2009) findings represented a mixture of these patterns: participants primed with security wrote more coherent descriptions of memories than did participants primed with attachment anxiety. However, the two groups did not differ on positive affect, negative affect, or emotional intensity in their narratives, and neither group differed significantly from the unprimed control group—even with respect to memory coherency. To summarize, *all* of the studies that included a security prime, an insecurity prime, and an unprimed control group found essentially no differences between an anxiety and security prime.

Taken together as a whole, the existing literature seems to suggest that security primes do, in fact, have a positive effect on various outcomes. However, it is unclear *why* security primes have a positive effect or if such primes *manipulate* attachment. Little information is available regarding the effects of priming *insecurity*—and the few well-designed studies that

---

<sup>17</sup> A total of 83 results were returned. Of these results, some were irrelevant to priming but contained homographs of the word “prime” (e.g., “...is a *prime* example of...”). Others mentioned attachment but contained primes designed to manipulate constructs other than attachment. Notably, this review was not designed to be completely comprehensive—it was only designed to provide a reasonable picture of the existing literature. Especially early work on attachment style priming (including Baldwin and colleagues' seminal 1996 paper) did not use priming terminology—and, as such, is not included in this review.

included an insecurity prime and unprimed control group suggest that security and insecurity primes generally do not have different impacts on outcome variables—and, in fact, insecurity primes occasionally have positive impacts on outcomes, as well (Gillath et al., 2010; Rowe et al., 2012). This seems to raise significant cause for concern regarding the construct validity of these primes. And to this end, the present studies seem to align with previous research suggesting that “anxiety” and “security” primes have similar effects (including none)(Bowles & Meyer, 2008; Carnelley & Rowe, 2010; Collins & Gillath, 2012; Gillath et al., 2010; Sutin & Gillath, 2009).

Based on the pattern of findings in the present studies in conjunction with previous research, I believe there are at least two alternative interpretations for *what* the primes were manipulating in the present studies. Of course, both explanations are purely speculative and should be thoroughly tested in future research. First, it is possible that any sort of attachment prime may “activate” people’s existing trait-level attachment styles (e.g., Beckes et al., 2010; Simpson et al., 2011). Second, it is possible that attachment primes serve a therapeutic function—temporarily increasing people’s wellbeing—similar to meditating on loving relationships (e.g., Fredrickson et al., 2008) or “talking cure”/“writing cure”/journaling therapies (e.g., Burton & King, 2008). Of course, these explanations are not mutually exclusive. It is possible that attachment primes simultaneously activate people’s existing trait attachment orientations, serve a therapeutic function, *and* temporarily shift people toward the primed attachment style.

**Do attachment primes “activate” people’s existing attachment styles?** Theoretically, the attachment system’s primary purpose is to provide feelings of safety and comfort by compelling people to establish emotional and physical proximity with caretakers—whether parents or romantic partners (Bowlby, 1969; Fraley & Shaver, 2000). As can be seen in Figure

1, when people feel threatened and perceive that their attachment figures are not available or responsive to their needs, they will *activate* attachment behaviors designed to increase physical and emotional closeness with their caretakers. It is when the attachment system is activated that individual differences (e.g., anxiety, avoidance) should be most clearly manifest (Simpson & Rholes, 1998). For example, highly avoidant individuals should pursue strategies of self-reliance and distancing from potential providers of support, whereas highly anxious people should engage in “hyper-vigilant” monitoring strategies designed to promote physical and emotional closeness with potential caretakers (e.g., Ein-Dor et al., 2011; Fraley et al., 2006; Fraley & Shaver, 2000).

Supporting this line of reasoning, a variety of studies have suggested that individual differences in attachment are most apparent in [1] relational contexts (e.g., Edelstein, 2006) or [2] when some sort of threat is present (e.g., Beckes et al., 2010; Simpson et al., 2011). For example, researchers might attempt to “activate” the attachment system by encouraging couples to talk about unresolved problems in their relationships (e.g., Simpson et al., 2011). Such manipulations seem to share many conceptual commonalities with “attachment primes” which ask participants to reflect on prior relational woes (e.g., Baldwin et al., 1996).

The idea that attachment primes activate or accentuate individual differences in attachment orientations is also consistent with theories of spreading activation. For instance, highly anxious individuals deeply associate relationships with intense desires for intimacy and fears of rejection (Hazan & Shaver, 1987; Mikulincer & Shaver, 2007). Asking people high in attachment anxiety to reflect upon prior relationship episodes—even positive ones—may inevitably activate the associated motives for intimacy and fears of rejection. Supporting this notion, several previous studies have shown that *positive* or *secure* attachment primes can cause relatively anxious people to feel increased negative affect (Mallinckrodt et al., 2013), better

remember *negative* (but not positive) details from stories (Miller & Noiro, 1999), and even drive more recklessly (Taubman-Ben-Ari & Mikulincer, 2007).

In a similar vein, close relationships are fundamentally a source of comfort and safety for relatively secure individuals (Hazan & Shaver, 1987; Mikulincer & Shaver, 2007); it may therefore be difficult to prime any sort of relationship—even negative relational episodes—without also activating the comfort and safety that relatively secure people associate with close relationships.

The idea that any sort of relational prime—whether positive or negative—simply activates people’s existing attachment styles could be directly tested in future research by asking participants to write about (1) a secure memory, (2) a memory characterized by attachment anxiety, (3) a memory that characterizes how they generally feel about close relationships, (4) a non-relational positive memory, (5) a non-relational negative memory, or (6) no memory (to serve as an unprimed control). To the extent that the relational primes all simply activate people’s existing attachment styles, recalling any sort of relational memory should cause secure individuals to behave in a more secure manner—and any sort of relational memory should cause relatively anxious individual to behave in manners consistent with hyper-activation of the attachment system (e.g., intense desires for intimacy, proximity seeking behaviors, monitoring close others for signs of rejection). These effects should not be observed in the affective prime groups or the unprimed control group.

**Do the attachment primes have therapeutic effects?** A second potential explanation for the effects observed in the present studies is that both primes had therapeutic effects—perhaps through different mechanisms. Previous research suggests that meditating on emotional connections with loved ones can lead to enhancements in positive affect, feelings of purpose in

life, and even physical health (Fredrickson et al., 2008). Indeed, merely writing about positive experiences is associated with increases in mood and physical health (Burton & King, 2004). Security primes—which ask participants to reflect upon positive experiences with loved ones—may operate via similar mechanisms. Such a phenomenon may partially explain why security primes have been repeatedly linked to a wide array of positive outcomes (e.g., Grau & Doll, 2003; Mikulincer et al., 2003, 2005; Mikulincer, Hirschberger, et al., 2001; Mikulincer & Shaver, 2001; Park, 2007; Rowe & Carnelley, 2003).

With respect to anxiety primes, previous research suggests that journaling about negative or traumatic experiences affords numerous psychological and physical benefits (King, 2002)—similar to the “talking cure” in psychotherapy. Although the exact therapeutic mechanism behind the “talking cure” and “writing cure” are not well understood (see Burton & King, 2004), the benefits of writing about traumatic or negative experiences can be observed after as few as two 2-minute journal sessions (Burton & King, 2008). Anxiety primes—which ask participants to write about or reflect upon a negative, anxiety-provoking relationship experience—may afford psychological benefits via the same mechanisms as the “writing cure.”

The idea that anxiety primes (or insecurity primes, in general) might carry therapeutic benefits helps explain why such primes have occasionally been associated with positive outcomes in previous research (Gabriel, Kawakami, Bartak, Kang, & Mann, 2010; Gillath et al., 2010; Rowe & Carnelley, 2003). Furthermore, such a phenomenon might explain why in the present studies, when asked to rate the valence of the visualization experience *per se* on a scale from “very negative” (1) to “very positive” (5), participants primed with high anxiety reported that the visualization process in and of itself was a positive experience—above the neutral scalar midpoint (3)—in both Study 1 ( $M = 3.24$ , 95% CI [3.08, 3.40]) and Study 2 ( $M = 3.12$ , 95% CI

[2.92, 3.32]). This may indicate that, although the memories that participants were reflecting upon were generally negative, the approximately 7-minute process of reimagining and “working through” those difficult memories was therapeutic.

Although the idea that both security primes and anxiety primes might provide therapeutic benefits explains why the security and anxiety primes functioned nearly identically to each other in both of the present studies (and in Gillath et al., 2010; Rowe et al., 2012), it is not without interpretative difficulties. For example, it is unclear why a therapeutic experience would cause *only* trait-secure individuals to experience reductions in false memories in Study 1. Similarly, although such an explanation helps elucidate why relatively trait-anxious individuals were generally more positive about Victoria and James in Study 2, it does not provide a satisfying explanation for why the primes caused relatively secure individuals to report relatively more *negative* impressions of Victoria and James.

Taken together, the present studies and previous research may suggest that attachment primes operate via multiple mechanisms. The primes may simultaneously activate people’s existing attachment styles, provide therapeutic benefits, and even slightly and temporarily shift people’s state level attachment toward the primed attachment style. A mix of all of these different processes might explain why anxiety and security primes function similarly to each other, yet have differential impacts on people with different trait-level attachment orientations. Clearly much future research is needed to understand precisely how attachment primes function.

That said, Hudson and Fraley are presently collecting data to test the idea that attachment primes—reflecting upon both experiences of security and attachment anxiety—have therapeutic properties. In an ongoing longitudinal study, some participants are being asked to write weekly about a security-fostering memory. Another group of participants is being asked to write weekly

about a memory that reflects themes relevant to attachment anxiety. Finally, a third group of participants is serving as an unprimed control. Participants in this study are providing biweekly ratings of their attachment working models, life satisfaction, and positive and negative affect from the prior week. These data will allow us to test the notion that, as compared with the unprimed control group, *both* repeated security priming and repeated anxiety priming will lead to increased attachment security, life satisfaction, and positive affect, and decreased negative affect.

### **Summary of the Present Research**

In summary, the pattern of findings in the present studies is somewhat ambiguous and difficult to interpret. Specifically, it may be the case that the primes used were valid manipulations of state-level attachment anxiety. If this is the case, the present studies suggest that attachment anxiety does *not* cause false memories during memory maintenance or retrieval processes. However, it is still possible that attachment anxiety *does*, in fact, produce false memories during encoding. This possibility should be tested in future research by priming attachment anxiety prior to encoding and examining the effects on subsequent false memories.

Alternatively, it is possible that contemporary methods used to “prime” attachment are actually not primarily valid manipulations of state-level attachment—but rather such primes may have other effects that are not well understood. For example, asking participants to reflect upon previous relational memories may simply activate and accentuate their existing trait-attachment styles (e.g., Beckes et al., 2010; Simpson et al., 2011). This possibility should be explored thoroughly by future research that primes multiple attachment styles and includes an unprimed control group. Such designs will enable researchers to determine whether attachment primes cause participants to think, feel, and behave in ways that align more closely with the primed

attachment style, or whether the primes influence people relative to their dispositional attachment orientations.

Finally, both reflecting on positive memories and “working through” negative memories may have therapeutic effects similar to meditating on loved ones (Fredrickson et al., 2008) or “writing cure” therapies (e.g., King, 2002). This possibility can be tested in future research by repeatedly priming episodes of security as well as insecurity, and ascertaining the impacts on wellbeing and self-reported trait-attachment over time.

Of course it is possible that attachment primes operate via multiple different mechanisms—activating existing attachment styles, offering therapeutic benefits, and potentially even slightly shifting participants’ state-level attachment in the desired direction.

### **Future Research Directions for Attachment and False Memories**

The first and most obvious research question spurred by the present studies is whether attachment anxiety causes false memories during encoding processes. Future research should test this possibility by priming attachment anxiety prior to encoding stimuli. Of course, such a study is not necessarily an optimal design, as it would only provide concrete information if priming anxiety prior to encoding did, in fact, produce false memories. If such a study failed to find a link between the prime and false alarms, a null finding might reflect a lack of causal association between attachment anxiety and false memories, or it might reflect methodological inadequacies in attempting to manipulate attachment orientations through priming.

Nevertheless, even barring attempts to *manipulate* participants’ attachment styles, there remain a plethora of important questions regarding links between attachment anxiety and propensity to false memories that future research should explore. For example, previous research suggests that the links between attachment avoidance and errors of *omission* (e.g.,



forgetting) primarily occur when the memory stimuli pertain to relational themes (e.g., Edelstein, 2006). Future research should similarly explore the domain specificity of the links between attachment anxiety and errors of *commission*. For instance, does anxiety predict false memories only for stories involving relational themes? Or does anxiety predict false memories only for information transmitted through relational means (e.g., a storyteller)? These questions could be evaluated using a randomized  $2 \times 2$  experimental design: participants view either a video of someone talking, or a video of equivalent duration and pacing in which the same dialog is presented via text with no other video or audio. Crossed with the human vs. text manipulation, the content of the video would pertain to relational themes (e.g., similar to the video used in the present studies) or some non-relational theme (e.g., describing a natural scene, like a forest). Such a design would enable researchers to isolate the effects of content domain (e.g., relational themes vs. not) and transmission method (e.g., story told by human vs. text) on the link between attachment anxiety and false memories.

Similarly, previous research utilizing clever designs has suggested that the links between attachment avoidance and errors of omission are due to motivated processes: highly avoidant individuals actively ignore relational stimuli and fail to encode them into memory (Edelstein, 2006; Fraley & Brumbaugh, 2007; Fraley, Garner, et al., 2000) and also appear to engage in effortful suppression of stored relational memories (Fraley et al., 1998; Mikulincer & Orbach, 1995). Researchers might use similarly clever designs to determine mechanisms through which attachment anxiety is related to false memories. For example, if attachment anxiety is related to false memories because highly anxious individuals attend more to cues for rejection (Fraley et al., 2006) at the expense of other details (thereby biasing their memories), false memories should be more prevalent among highly anxious individuals for lab stimuli that is explicitly designed to

contain many distracting rejection cues alongside the target material, as opposed to for lab stimuli designed to contain as few rejection cues as is possible alongside the target material.

Future researchers should also employ longitudinal designs to better understand links between attachment anxiety and false memories. For instance, on the most basic level, do anxious individuals in particular experience greater increases in false memories with increasing time delays, as compared with their more secure counterparts? Does attachment anxiety covary with propensity to experience false memories over time, perhaps suggesting a stronger link between the two (Roberts, Wood, & Caspi, 2008)? Researchers could also repeatedly track written accounts of memories over time and code responses to elucidate any particular themes or commonalities in the types of false memories that highly anxious individuals experience.

## **Conclusion**

The present studies replicated previous research linking high trait-levels of attachment anxiety to an increased propensity to experience false memories on recognition memory tests (Hudson & Fraley, in preparation). In contrast, the present studies were unable to provide clear information on whether attachment anxiety *causes* false memories—namely because of the questionable construct validity of the method used to manipulate attachment anxiety. It is potentially possible that priming manipulations *do*, in fact, manipulate state-level attachment orientations (in addition to exerting other effects), and that future studies will find that priming attachment anxiety prior to encoding leads to subsequent false memories. Nevertheless, even if future studies reveal that attachment orientations cannot be manipulated through priming, there remains a wealth of interesting and important questions regarding the now multiply-replicated correlational links between attachment anxiety and false memories.

## REFERENCES

- Baldwin, M. W., & Fehr, B. (1995). On the instability of attachment style ratings. *Personal Relationships*, 2, 247–261.
- Baldwin, M. W., Keelan, J. P. R., Fehr, B., Enns, V., & Koh-Rangarajoo, E. (1996). Social-cognitive conceptualization of attachment working models: Availability and accessibility effects. *Journal of Personality and Social Psychology*, 71, 94–109.
- Bartholomew, K., & Horowitz, L. M. (1991). Attachment styles among young adults: A test of a four-category model. *Journal of Personality and Social Psychology*, 61, 226–244.
- Bartz, J. A., & Lydon, J. E. (2004). Close relationships and the working self-concept: Implicit and explicit effects of priming attachment on agency and communion. *Personality and Social Psychology Bulletin*, 30, 1389–1401.
- Beckes, L., Simpson, J. A., & Erickson, A. (2010). Of snakes and succor: Learning secure attachment associations with novel faces via negative stimulus pairings. *Psychological Science*, 21, 721–728.
- Beck, R., & McDonald, A. (2004). Attachment to God: The attachment to God inventory, tests of working model correspondence, and an exploration of faith group differences. *Journal of Psychology and Theology*, 32, 92–103.
- Birnbaum, G. E., Simpson, J. A., Weisberg, Y. J., Barnea, E., & Assulin-Simhon, Z. (2012). Is it my overactive imagination? The effects of contextually activated attachment insecurity on sexual fantasies. *Journal of Social and Personal Relationships*, 29, 1131–1152.
- Boag, E. M., & Carnelley, K. B. (2012). Self-reported discrimination and discriminatory behaviour: The role of attachment security. *British Journal of Social Psychology*, 51, 393–403.

- Bowlby, J. (1969). *Attachment*. New York, NY: Basic Books.
- Bowles, D. P., & Meyer, B. (2008). Attachment priming and avoidant personality features as predictors of social-evaluation biases. *Journal of Personality Disorders*, 22, 72–88.
- Brainerd, C. J., & Reyna, V. F. (2002). Fuzzy-trace theory and false memory. *Current Directions in Psychological Science*, 11, 164–169.
- Burton, C. M., & King, L. A. (2004). The health benefits of writing about intensely positive experiences. *Journal of Research in Personality*, 38, 150–163.
- Burton, C. M., & King, L. A. (2008). Effects of (very) brief writing on health: The two-minute miracle. *British Journal of Health Psychology*, 13, 9–14.
- Button, K. S., Ioannidis, J. P. A., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S. J., & Munafò, M. R. (2013). Power failure: Why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience*, 14, 1–12.
- Carnelley, K. B., & Rowe, A. C. (2007). Repeated priming of attachment security influences later views of self and relationships. *Personal Relationships*, 14, 307–320.
- Carnelley, K. B., & Rowe, A. C. (2010). Priming a sense of security: What goes through people's minds? *Journal of Social and Personal Relationships*, 27, 253–261.
- Cassidy, J., Shaver, P. R., Mikulincer, M., & Lavy, S. (2009). Experimentally induced security influences responses to psychological pain. *Journal of Social and Clinical Psychology*, 28, 463–478.
- Chugh, D., Kern, M. C., Zhu, Z., & Lee, S. (2014). Withstanding moral disengagement. *Journal of Experimental Social Psychology*, 51, 88–93.
- Collins, N. L., Guichard, A. C., Ford, M. B., & Feeney, B. C. (2004). Working models of attachment. New developments and emerging themes. In W. S. Rholes & J. A. Simpson

- (Eds.), *Adult attachment: Theory, research, and clinical implications* (pp. 196–239). New York, NY: Guilford Press.
- Collins, T. J., & Gillath, O. (2012). Attachment, breakup strategies, and associated outcomes: The effects of security enhancement on the selection of breakup strategies. *Journal of Research in Personality*, 46, 210–222.
- Cozzarelli, C., Hoekstra, S. J., & Bylsma, W. H. (2000). General versus specific mental models of attachment: Are they associated with different outcomes? *Personality and Social Psychology Bulletin*, 26, 605–618.
- Cozzarelli, C., Karafa, J. A., Collins, N. L., & Tagler, M. J. (2003). Stability and change in adult attachment styles: associations with personal vulnerabilities, life events, and global construals of self and others. *Journal of Social and Clinical Psychology*, 22, 315–346.
- Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review*, 93, 283–321.
- Dobbins, I. G., Khoe, W., Yonelinas, A. P., & Kroll, N. E. (2000). Predicting individual false alarm rates and signal detection theory: A role for remembering. *Memory & Cognition*, 28, 1347–1356.
- Doron, G., Sar-El, D., Mikulincer, M., & Talmor, D. (2012). Experimentally-enhanced attachment security influences obsessive compulsive related washing tendencies in a non-clinical sample. *Sensoria: A Journal of Mind, Brain & Culture*, 8, 1–8.
- Dunlop, P. D., Telford, A. D., & Morrison, D. L. (2012). Not too little, but not too much: The perceived desirability of responses to personality items. *Journal of Research in Personality*, 46, 8–18.

- Dykas, M. J., Woodhouse, S. S., Ehrlich, K. B., & Cassidy, J. (2010). Do adolescents and parents reconstruct memories about their conflict as a function of adolescent attachment? *Child Development, 81*, 1445–1459.
- Dykas, M. J., Woodhouse, S. S., Ehrlich, K. B., & Cassidy, J. (2012). Attachment-related differences in perceptions of an initial peer interaction emerge over time: Evidence of reconstructive memory processes in adolescents. *Developmental Psychology, 48*, 1381–1389.
- Edelstein, R. S. (2006). Attachment and emotional memory: Investigating the source and extent of avoidant memory impairments. *Emotion, 6*, 340–345.
- Edelstein, R. S., Ghatti, S., Quas, J. A., Goodman, G. S., Alexander, K. W., Redlich, A. D., & Cordon, I. M. (2005). Individual differences in emotional memory: Adult attachment and long-term memory for child sexual abuse. *Personality and Social Psychology Bulletin, 31*, 1537–1548.
- Ein-Dor, T., Mikulincer, M., Doron, G., & Shaver, P. R. (2010). The attachment paradox: How can so many of us (the insecure ones) have no adaptive advantages? *Perspectives on Psychological Science, 5*, 123–141.
- Ein-Dor, T., Mikulincer, M., & Shaver, P. R. (2011). Attachment insecurities and the processing of threat-related information: Studying the schemas involved in insecure people's coping strategies. *Journal of Personality and Social Psychology, 101*, 78–93.
- Feeney, B. C., & Cassidy, J. (2003). Reconstructive memory related to adolescent-parent conflict interactions: The influence of attachment-related representations on immediate perceptions and changes in perceptions over time. *Journal of Personality and Social Psychology, 85*, 945–955.

- Feeney, B. C., & Collins, N. L. (2001). Predictors of caregiving in adult intimate relationships: An attachment theoretical perspective. *Journal of Personality and Social Psychology*, 80, 972–994.
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7, 117–140.
- Fraley, R. C. (2002). Attachment stability from infancy to adulthood: Meta-analysis and dynamic modeling of developmental mechanisms. *Personality and Social Psychology Review*, 6, 123–151.
- Fraley, R. C., & Brumbaugh, C. C. (2004). A dynamical systems approach to understanding stability and change in attachment security. In W. S. Rholes & J. A. Simpson (Eds.), *Adult attachment: Theory, research, and clinical implications* (pp. 86–132). New York: Guilford Press.
- Fraley, R. C., & Brumbaugh, C. C. (2007). Adult attachment and preemptive defenses: Converging evidence on the role of defensive exclusion at the level of encoding. *Journal of Personality*, 75, 1033–1050.
- Fraley, R. C., & Davis, K. E. (1997). Attachment formation and transfer in young adults' close friendships and romantic relationships. *Personal Relationships*, 4, 131–144.
- Fraley, R. C., Davis, K. E., & Shaver, P. R. (1998). Dismissing-avoidance and the defensive organization of emotion, cognition, and behavior. In J. A. Simpson & W. S. Rholes (Eds.), *Attachment Theory and Close Relationships*. New York, NY: Guilford Press.
- Fraley, R. C., Garner, J. P., & Shaver, P. R. (2000). Adult attachment and the defensive regulation of attention and memory: examining the role of preemptive and postemptive defensive processes. *Journal of Personality and Social Psychology*, 79, 816–826.

- Fraley, R. C., Heffernan, M. E., Vicary, A. M., & Brumbaugh, C. C. (2011). The Experiences in Close Relationships—Relationship Structures questionnaire: A method for assessing attachment orientations across relationships. *Psychological Assessment, 23*, 615–625.
- Fraley, R. C., Hudson, N. W., Heffernan, M. E., & Segal, N. (2015). Are adult attachment styles categorical or dimensional? A taxometric analysis of general and relationship-specific attachment orientations. *Journal of Personality and Social Psychology*, in press.
- Fraley, R. C., Niedenthal, P. M., Marks, M., Brumbaugh, C., & Vicary, A. (2006). Adult attachment and the perception of emotional expressions: Probing the hyperactivating strategies underlying anxious attachment. *Journal of Personality, 74*, 1163–1190.
- Fraley, R. C., & Shaver, P. R. (2000). Adult romantic attachment: Theoretical developments, emerging controversies, and unanswered questions. *Review of General Psychology, 4*, 132–154.
- Fraley, R. C., Vicary, A. M., Brumbaugh, C. C., & Roisman, G. I. (2011). Patterns of stability in adult attachment: An empirical test of two models of continuity and change. *Journal of Personality and Social Psychology, 101*, 974–992.
- Fraley, R. C., Waller, N. G., & Brennan, K. A. (2000). An item response theory analysis of self-report measures of adult attachment. *Journal of Personality and Social Psychology, 78*, 350–365.
- Fredrickson, B. L., Cohn, M. A., Coffey, K. A., Pek, J., & Finkel, S. M. (2008). Open hearts build lives: positive emotions, induced through loving-kindness meditation, build consequential personal resources. *Journal of Personality and Social Psychology, 95*, 1045.



- Gabriel, S., Kawakami, K., Bartak, C., Kang, S.-J., & Mann, N. (2010). Negative self-synchronization: will I change to be like you when it is bad for me? *Journal of Personality and Social Psychology*, 98, 857–871.
- Gentzler, A., & Kerns, K. (2006). Adult attachment and memory of emotional reactions to negative and positive events. *Cognition & Emotion*, 20, 20–42.
- Gillath, O., Giesbrecht, B., & Shaver, P. R. (2009). Attachment, attention, and cognitive control: Attachment style and performance on general attention tasks. *Journal of Experimental Social Psychology*, 45, 647–654.
- Gillath, O., Milkulincer, M., Fitzsimons, G. M., Shaver, P. R., Schachner, D. A., & Bargh, J. A. (2006). Automatic activation of attachment-related goals. *Personality and Social Psychology Bulletin*, 32, 1375–1388.
- Gillath, O., Selcuk, E., & Shaver, P. R. (2008). Moving toward a secure attachment style: Can repeated security priming help? *Social and Personality Psychology Compass*, 2, 1651–1666.
- Gillath, O., Sesko, A. K., Shaver, P. R., & Chun, D. S. (2010). Attachment, authenticity, and honesty: dispositional and experimentally induced security can reduce self-and other-deception. *Journal of Personality and Social Psychology*, 98, 841–855.
- Goodman, G. S., Ogle, C. M., Block, S. D., Harris, L. S., Larson, R. P., Augusti, E.-M., ... Urquiza, A. (2011). False memory for trauma-related Deese–Roediger–McDermott lists in adolescents and adults with histories of child sexual abuse. *Development and Psychopathology*, 23, 423–438.
- Gosling, S. D., Rentfrow, P. J., & Swann, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, 37, 504–528.

- Grabill, C. M., & Kerns, K. A. (2000). Attachment style and intimacy in friendship. *Personal Relationships*, 7, 363–378.
- Grau, I., & Doll, J. (2003). Effects of attachment styles on the experience of equity in heterosexual couples relationships. *Experimental Psychology*, 50, 298–310.
- Haggerty, G. D., Siefert, C. J., & Weinberger, J. (2010). Examining the relationship between current attachment status and freely recalled autobiographical memories of childhood. *Psychoanalytic Psychology*, 27, 27–41.
- Hazan, C., & Shaver, P. (1987). Romantic love conceptualized as an attachment process. *Journal of Personality and Social Psychology*, 52, 511–524.
- Hudson, N. W., & Fraley, R. C. (2015). Attachment anxiety predicts false memories. *Unpublished Manuscript*.
- John, O. P., & Srivastava, S. (1999). The Big-Five trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.), *Handbook of Personality: Theory and Research* (2nd ed., pp. 102–138). New York: Guilford Press.
- Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, 114, 3–28.
- Jou, J., & Flores, S. (2012). How are false memories distinguishable from true memories in the Deese–Roediger–McDermott paradigm? A review of the findings. *Psychological Research*, 77, 671–686.
- King, L. A. (2002). Gain without pain: Expressive writing and self-regulation. In S. J. Lepore & J. Smythe (Eds.), *The Writing Cure*. Washington, DC: American Psychological Association.

- Kohn, J. L., Rholes, W. S., & Schmeichel, B. J. (2012). Self-regulatory depletion and attachment avoidance: Increasing the accessibility of negative attachment-related memories. *Journal of Experimental Social Psychology, 48*, 375–378.
- LeBel, E. P., & Peters, K. R. (2011). Fearing the future of empirical psychology: Bem's (2011) evidence of psi as a case study of deficiencies in modal research practice. *Review of General Psychology, 15*, 371–379.
- Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior, 13*, 585–589.
- Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals, 25*, 720–725.
- Luke, M. A., Sedikides, C., & Carnelley, K. (2012). Your love lifts me higher! The energizing quality of secure relationships. *Personality and Social Psychology Bulletin, 38*, 721–733.
- Macmillan, N. A., & Creelman, C. D. (1991). *Detection Theory: A User's Guide*. New York, NY: Cambridge University Press.
- Mallinckrodt, B., McNett, A. M. S., Celebi, E., Birks, K. M., Tsai, C.-L., & Williams, B. E. (2013). Cognitive primes for attachment security can increase cultural empathy, but also interact negatively with attachment anxiety. *Journal of Social and Clinical Psychology, 32*, 1013–1039.
- McClure, M. J., Bartz, J. A., & Lydon, J. E. (2013). Uncovering and overcoming ambivalence: The role of chronic and contextually activated attachment in two-person social dilemmas. *Journal of Personality, 81*, 103–117.

McWilliams, K., Goodman, G. S., Lyons, K. E., Newton, J., & Avila-Mora, E. (2013). Memory for child sexual abuse information: Simulated memory error and individual differences.

*Memory & Cognition*, 42, 151–163.

Mikulincer, M., Gillath, O., Halevy, V., Avihou, N., Avidan, S., & Eshkoli, N. (2001).

Attachment theory and reactions to others' needs: Evidence that activation of the sense of attachment security promotes empathic responses. *Journal of Personality and Social Psychology*, 81, 1205–1224.

Mikulincer, M., Gillath, O., Sapir-Lavid, Y., Yaakobi, E., Arias, K., Tal-Aloni, L., & Bor, G.

(2003). Attachment theory and concern for others' welfare: Evidence that activation of the sense of secure base promotes endorsement of self-transcendence values. *Basic and Applied Social Psychology*, 25, 299–312.

Mikulincer, M., Hirschberger, G., Nachmias, O., & Gillath, O. (2001). The affective component of the secure base schema: Affective priming with representations of attachment security.

*Journal of Personality and Social Psychology*, 81, 305–321.

Mikulincer, M., & Orbach, I. (1995). Attachment styles and repressive defensiveness: The

accessibility and architecture of affective memories. *Journal of Personality and Social Psychology*, 68, 917–925.

Mikulincer, M., & Shaver, P. R. (2001). Attachment theory and intergroup bias: evidence that priming the secure base schema attenuates negative reactions to out-groups. *Journal of*

*Personality and Social Psychology*, 81, 97–115.

Mikulincer, M., & Shaver, P. R. (2007). *Attachment in adulthood: Structure, dynamics, and change*. New York: Guilford Press.

- Mikulincer, M., Shaver, P. R., Bar-On, N., & Sahdra, B. K. (2014). Security enhancement, self-esteem threat, and mental depletion affect provision of a safe haven and secure base to a romantic partner. *Journal of Social and Personal Relationships*, 31, 630–650.
- Mikulincer, M., Shaver, P. R., Gillath, O., & Nitzberg, R. A. (2005). Attachment, caregiving, and altruism: boosting attachment security increases compassion and helping. *Journal of Personality and Social Psychology*, 89, 817–839.
- Mikulincer, M., Shaver, P. R., & Rom, E. (2011). The effects of implicit and explicit security priming on creative problem solving. *Cognition and Emotion*, 25, 519–531.
- Mikulincer, M., Shaver, P. R., Sahdra, B. K., & Bar-On, N. (2013). Can security-enhancing interventions overcome psychological barriers to responsiveness in couple relationships? *Attachment & Human Development*, 15, 246–260.
- Miller, J. B. (2001). Attachment models and memory for conversation. *Journal of Social and Personal Relationships*, 18, 404–422.
- Miller, J. B., & Noirot, M. (1999). Attachment memories, models and information processing. *Journal of Social and Personal Relationships*, 16, 147–173.
- Park, L. E. (2007). Appearance-based rejection sensitivity: Implications for mental and physical health, affect, and motivation. *Personality and Social Psychology Bulletin*, 33, 490–504.
- Pereg, D., & Mikulincer, M. (2004). Attachment style and the regulation of negative affect: Exploring individual differences in mood congruency effects on memory and judgment. *Personality and Social Psychology Bulletin*, 30, 67–80.
- Pierce, T., & Lydon, J. E. (2001). Global and specific relational models in the experience of social interactions. *Journal of Personality and Social Psychology*, 80, 613–631.

- Qin, J., Ogle, C. M., & Goodman, G. S. (2008). Adults' memories of childhood: True and false reports. *Journal of Experimental Psychology: Applied*, 14, 373–391.
- Richard, F. D., Bond, C. F., & Stokes-Zoota, J. J. (2003). One hundred years of social psychology quantitatively described. *Review of General Psychology*, 7, 331–363.
- Roberts, B. W., Wood, D., & Caspi, A. (2008). The development of personality traits in adulthood. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of Personality: Theory and Research* (3rd ed., pp. 375–398). New York, NY: The Guilford Press.
- Rom, E., & Mikulincer, M. (2003). Attachment theory and group processes: The association between attachment style and group-related representations, goals, memories, and functioning. *Journal of Personality and Social Psychology*, 84, 1220–1235.
- Rowe, A., & Carnelley, K. B. (2003). Attachment style differences in the processing of attachment-relevant information: Primed-style effects on recall, interpersonal expectations, and affect. *Personal Relationships*, 10, 59–75.
- Rowe, A. C., Carnelley, K. B., Harwood, J., Micklewright, D., Russouw, L., Rennie, C. L., & Liossi, C. (2012). The effect of attachment orientation priming on pain sensitivity in pain-free individuals. *Journal of Social and Personal Relationships*, 29, 488–507.
- Seltermann, D. F., & Maier, M. A. (2013). Secure attachment and material reward both attenuate romantic jealousy. *Motivation and Emotion*, 37, 765–775.
- Sibley, C. G., & Overall, N. C. (2008). Modeling the hierarchical structure of attachment representations: A test of domain differentiation. *Personality and Individual Differences*, 44, 238–249.

- Sibley, C. G., & Overall, N. C. (2010). Modeling the hierarchical structure of personality-attachment associations: Domain diffusion versus domain differentiation. *Journal of Social and Personal Relationships*, 27, 47–70.
- Simpson, J. A., Kim, J. S., Fillo, J., Ickes, W., Rholes, W. S., Orina, M. M., & Winterheld, H. A. (2011). Attachment and the management of empathic accuracy in relationship-threatening situations. *Personality and Social Psychology Bulletin*, 37, 242–254.
- Simpson, J. A., & Rholes, W. S. (1998). *Attachment theory and close relationships*. New York, NY: The Guilford Press.
- Simpson, J. A., Rholes, W. S., & Winterheld, H. A. (2009). Attachment working models twist memories of relationship events. *Psychological Science*, 21, 252–259.
- Stadler, M. A., Roediger, H. L., & McDermott, K. B. (1999). Norms for word lists that create false memories. *Memory & Cognition*, 27, 494–500.
- Straube, B. (2012). An overview of the neuro-cognitive processes involved in the encoding, consolidation, and retrieval of true and false memories. *Behavioral and Brain Functions*, 8, 1–10.
- Sutin, A. R., & Gillath, O. (2009). Autobiographical memory phenomenology and content mediate attachment style and psychological distress. *Journal of Counseling Psychology*, 56, 351–364.
- Taubman-Ben-Ari, O., & Mikulincer, M. (2007). The effects of dispositional attachment orientations and contextual priming of attachment security on reckless driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, 10, 123–138.
- Van Emmichoven, I. A. Z., van Ijzendoorn, M. H., De Ruiter, C. D., & Brosschot, J. F. (2003). Selective processing of threatening information: Effects of attachment representation and

- anxiety disorder on attention and memory. *Development and Psychopathology*, 15, 219–237.
- Wagner, U., Gais, S., Haider, H., Verleger, R., & Born, J. (2004). Sleep inspires insight. *Nature*, 427, 352–355.
- Wei, M., Russell, D. W., Mallinckrodt, B., & Vogel, D. L. (2007). The Experiences in Close Relationship Scale (ECR)-short form: Reliability, validity, and factor structure. *Journal of Personality Assessment*, 88, 187–204.
- Weise, D. R., Pyszczynski, T., Cox, C. R., Arndt, J., Greenberg, J., Solomon, S., & Kosloff, S. (2008). Interpersonal politics the role of terror management and attachment processes in shaping political preferences. *Psychological Science*, 19, 448–455.
- Wilson, C. L. (2006). *Attachment working models and false recall: a category structure approach*. Texas A&M University. Retrieved from <http://repository.tamu.edu/bitstream/handle/1969.1/ETD-TAMU-1857/WILSON-DISSERTATION.pdf?sequence=1>
- Woodhouse, S. S., & Gelso, C. J. (2008). Volunteer client adult attachment, memory for in-session emotion, and mood awareness: An affect regulation perspective. *Journal of Counseling Psychology*, 55, 197–208.
- Wright, D. B., & Loftus, E. F. (1998). How misinformation alters memories. *Journal of Experimental Child Psychology*, 71, 155–164.
- Zaragoza, M. S., Mitchell, K. J., Payment, K., & Drivdahl, S. (2011). False memories for suggestions: The impact of conceptual elaboration. *Journal of Memory and Language*, 64, 18–31.



## APPENDIX A: TABLES AND FIGURES

*Table 1a.* Study 1 direct replication of Hudson & Fraley's (in preparation) correlational trait partner-specific attachment anxiety/false memory effect.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.70</b>	-	-	-
Item True	<b>1.80</b>	<b>6.05</b>	5.60	6.55
Trait Anxiety <sup>†</sup>	<b>0.09</b>	<b>1.10</b>	1.03	1.18
Item True × Trait Anxiety	<b>-0.08</b>	<b>0.92</b>	0.85	0.997

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

<sup>†</sup> Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple effect of trait anxiety on *false* items.

*Table 1b.* Study 1 “conceptual replication” of Hudson & Fraley’s (in preparation) correlational attachment anxiety/false memory effect, using ECR-S general-romantic scale.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.70</b>	-	-	-
Item True	<b>1.80</b>	<b>6.06</b>	5.60	6.55
Trait Anxiety <sup>†</sup>	<b>0.10</b>	<b>1.10</b>	1.03	1.18
Item True × Trait Anxiety	-0.08	0.93	0.86	1.003

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

<sup>†</sup> Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple effect of trait anxiety on *false* items.

*Table 2a.* Study 1 MLLM predicting odds of endorsing memory items as function of high anxiety prime vs. both control groups collapsed together.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.69</b>	-	-	-
Item True	<b>1.78</b>	<b>5.95</b>	5.41	6.55
High Anxiety Prime†	-0.02	0.99	0.85	1.14
Item True × High Anxiety Prime	0.05	1.06	0.89	1.25
Trait Anxiety	<b>0.07</b>	<b>1.07</b>	1.01	1.14
Trait Avoidance	-0.05	0.96	0.90	1.02

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple effect of the anxiety prime on *false* items.

*Table 2b.* Study 1 MLLM analyses predicting odds of endorsing memory items as a function of each individual prime compared with the unprimed control group.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.64</b>	-	-	-
Item True	<b>1.72</b>	<b>5.56</b>	4.85	6.37
High Anxiety Prime†	-0.07	0.93	0.79	1.11
Security Prime†	-0.10	0.90	0.76	1.06
Item True × High Anxiety Prime	0.12	1.13	0.93	1.37
Item True × Security Prime	0.14	1.14	0.94	1.39
Trait Anxiety	<b>0.07</b>	<b>1.07</b>	1.01	1.14
Trait Avoidance	-0.04	0.96	0.90	1.02

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), and the conditions were dummy coded with the “unprimed control group” as the reference group, these coefficients represent simple effects of each prime on *false* items, as compared with the unprimed control group.

*Table 2c.* Study 1 MLLM analyses predicting odds of endorsing memory items as a function of both primes collapsed together vs. the unprimed control group.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.64</b>	-	-	-
Item True	<b>1.72</b>	<b>5.56</b>	4.85	6.37
Primed†	-0.09	0.92	0.79	1.06
Item True × Primed	0.13	1.14	0.96	1.34
Trait Anxiety	<b>0.07</b>	<b>1.07</b>	1.01	1.14
Trait Avoidance	-0.05	0.96	0.90	1.02

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple effect of the primes on *false* items.

*Table 3a.* Study 1 interaction between individual primes and trait anxiety in predicting endorsement of memory items.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.64</b>	-	-	-
Item True	<b>1.71</b>	<b>5.54</b>	4.84	6.35
High Anxiety Prime†	-0.08	0.92	0.78	1.10
Security Prime†	-0.10	0.90	0.77	1.07
Trait Anxiety*	-0.02	0.98	0.87	1.12
Item True × High Anxiety Prime	0.14	1.15	0.94	1.39
Item True × Security Prime	0.12	1.13	0.93	1.37
Item True × Trait Anxiety*	0.13	1.13	0.98	1.31
High Anxiety Prime × Trait Anxiety†	0.15	1.17	0.99	1.38
Security Prime × Trait Anxiety†	<b>0.19</b>	<b>1.21</b>	1.02	1.44
Item True × High Anxiety Prime × Trait Anxiety	<b>-0.28</b>	<b>0.76</b>	0.63	0.92
Item True × Security Prime × Trait Anxiety	<b>-0.30</b>	<b>0.74</b>	0.61	0.90
Trait Avoidance	-0.04	0.96	0.90	1.02

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), and the conditions were dummy coded with the “unprimed control group” as the reference group, these coefficients represent simple effects of each prime on *false* items, as compared with the unprimed control group.

\* Because the conditions were dummy coded with the “unprimed control group” as the reference condition, these coefficients represent the simple slopes of anxiety in the unprimed control group.

*Table 3b.* Study 1 interaction of both prime groups collapsed together with trait anxiety in predicting endorsement of memory items.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.64</b>	-	-	-
Item True	<b>1.71</b>	<b>5.54</b>	4.84	6.35
Primed†	-0.09	0.91	0.79	1.06
Trait Anxiety*	-0.02	0.98	0.87	1.12
Item True × Primed	0.13	1.14	0.96	1.35
Item True × Trait Anxiety*	0.13	1.13	0.98	1.31
Primed × Trait Anxiety†	<b>0.17</b>	<b>1.19</b>	1.02	1.38
Item True × Primed × Trait Anxiety	<b>-0.29</b>	<b>0.75</b>	0.63	0.89
Trait Avoidance	-0.04	0.96	0.90	1.02

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), this coefficient represents the simple effect of the primes on *false* items.

\* Because the conditions are dummy coded with the “unprimed control group” as the reference condition, these effects represent the simple slopes of anxiety in the unprimed control group.

*Table 4a.* Study 2 direct replication of Hudson & Fraley's (in preparation) correlational trait partner-specific attachment anxiety/false memory effect.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.75</b>	-	-	-
Item True	<b>1.90</b>	<b>6.65</b>	6.59	7.19
Trait Anxiety <sup>†</sup>	0.05	1.05	0.98	1.11
Item True × Trait Anxiety	0.03	1.03	0.96	1.12

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

<sup>†</sup> Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple slope of trait anxiety for *false* items.



*Table 4b.* Study 2 “conceptual replication” of Hudson & Fraley’s (in preparation) correlational attachment anxiety/false memory effect, using ECR-S general-romantic scale.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.75</b>	-	-	-
Item True	<b>1.89</b>	<b>6.65</b>	6.15	7.18
Trait Anxiety <sup>†</sup>	0.04	1.04	0.98	1.11
Item True × Trait Anxiety	0.00	1.00	0.93	1.08

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

<sup>†</sup> Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple slope of trait anxiety for *false* items.

Table 5. Study 2 “preregistered” analyses: Does the manipulation affect gist impressions of Victoria and James?

Predictor	Time 2 Gist Impressions of:								
	Victoria			James			Overall		
	<i>b</i>	95% CI		<i>b</i>	95% CI		<i>b</i>	95% CI	
		LB	UB		LB	UB		LB	UB
Intercept	-0.03	-0.14	0.09	-0.02	-0.14	0.10	-0.04	-0.17	0.09
High Anxiety Prime†	-0.01	-0.18	0.16	-0.01	-0.18	0.16	-0.02	-0.21	0.17
Security Prime†	0.08	-0.08	0.25	0.05	-0.12	0.22	0.11	-0.07	0.29
Trait Anxiety	0.00	-0.07	0.07	-0.05	-0.12	0.02	-0.04	-0.12	0.04
Trait Avoidance	<b>-0.07</b>	-0.14	-0.004	0.05	-0.02	0.12	-0.02	-0.11	0.05
Relevant Gist, Time 1	<b>0.84</b>	0.77	0.91	<b>0.83</b>	0.75	0.90	<b>0.79</b>	0.72	0.87

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 0.00; all variables, including the outcome, are standardized *except* the prime groups, which are dummy coded. As such, the coefficients for prime groups are similar to *ds*, and all other coefficients are similar to  $\beta$ s.

† Because the conditions were dummy coded with the “unprimed control group” as the reference groups, these represent the effects of the primes, relative to the unprimed control group.

Table 6. Study 2: Does the manipulation interact with trait attachment styles to predict changes in gist impressions over time?

Predictor	Time 2 Gist Impressions of:								
	Victoria			James			Overall		
	<i>b</i>	95% CI		<i>b</i>	95% CI		<i>b</i>	95% CI	
		LB	UB		LB	UB		LB	UB
Intercept	-0.03	-0.15	0.08	-0.03	-0.15	0.09	-0.05	-0.17	0.08
High Anxiety Prime†	-0.01	-0.18	0.15	-0.01	-0.18	0.16	-0.03	-0.21	0.16
Security Prime†	0.09	-0.07	0.25	0.06	-0.11	0.22	0.12	-0.06	0.30
Trait Anxiety*	-0.10	-0.21	0.02	<b>-0.16</b>	-0.27	-0.04	<b>-0.20</b>	-0.33	-0.08
Trait Avoidance	<b>-0.07</b>	-0.14	-0.004	0.05	-0.02	0.12	-0.03	-0.10	0.05
Relevant Gist, Time 1	<b>0.84</b>	0.77	0.90	<b>0.83</b>	0.75	0.90	<b>0.80</b>	0.71	0.87
High Anxiety Prime × Trait Anxiety	0.15	-0.01	0.32	0.16	-0.01	0.33	<b>0.27</b>	0.08	0.46
Security Prime × Trait Anxiety	0.15	-0.01	0.31	<b>0.17</b>	0.004	0.33	<b>0.24</b>	0.06	0.42

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 0.00; all variables, including the outcome, are standardized *except* the prime groups, which are dummy coded. As such, the coefficients for prime groups are similar to *ds*, the coefficients for traits are similar to  $\beta$ s, and the trait × prime interactions are the difference in standardized associations between traits and endorsement of items ( $\Delta\beta$ ) between the prime group and unprimed control group.

† Because the conditions were dummy coded with the “unprimed control group” as the reference groups, these coefficients represent the effects of the primes, relative to the unprimed control group.

\* Because the conditions were dummy coded with the “unprimed control group” as the reference groups, this coefficient represents the simple slope of anxiety in the control group.

*Table 7a.* Study 2 MLLM predicting odds of endorsing memory items as function of high anxiety prime vs. both control groups collapsed together.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.77</b>	-	-	-
Item True	<b>1.89</b>	<b>6.61</b>	6.03	7.25
High Anxiety Prime†	0.04	1.04	0.91	1.19
Item True × High Anxiety Prime	0.02	1.02	0.86	1.20
Trait Anxiety	0.03	1.03	0.98	1.09
Trait Avoidance	<b>0.05</b>	<b>1.06</b>	1.001	1.11

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple effect of the high anxiety prime on *false* items.

*Table 7b.* Study 2 MLLM analyses predicting odds of endorsing memory items as a function of individual prime groups.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.78</b>	-	-	-
Item True	<b>1.92</b>	<b>6.80</b>	5.96	7.76
High Anxiety Prime†	0.06	1.06	0.91	1.24
Security Prime†	0.04	1.04	0.89	1.20
Item True × High Anxiety Prime	-0.01	0.99	0.82	1.20
Item True × Security Prime	-0.06	0.95	0.79	1.14
Trait Anxiety	0.03	1.03	0.98	1.09
Trait Avoidance	0.05	1.05	1.00	1.11

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), and the conditions were dummy coded with the “unprimed control group” as the reference group, these coefficients represent simple effects of each prime on *false* items, as compared with the unprimed control group.

*Table 7c.* Study 2 MLLM comparing effect of both prime groups collapsed together vs. the unprimed control group on endorsement of memory items.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.78</b>	-	-	-
Item True	<b>1.92</b>	<b>6.80</b>	5.96	7.76
Primed†	0.05	1.05	0.92	1.19
Item True × Primed	-0.03	0.97	0.82	1.14
Trait Anxiety	0.03	1.03	0.98	1.09
Trait Avoidance	0.05	1.05	0.998	1.11

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), this is the simple effect of the primes on *false* items.

*Table 8a.* Study 2 interaction between individual primes and trait anxiety in predicting endorsement of memory items.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.78</b>	-	-	-
Item True	<b>1.92</b>	<b>6.79</b>	5.95	7.75
High Anxiety Prime†	0.06	1.06	0.90	1.24
Security Prime†	0.03	1.03	0.89	1.20
Trait Anxiety*	0.03	1.03	0.92	1.14
Item True × High Anxiety Prime	0.00	1.00	0.82	1.21
Item True × Security Prime	-0.05	0.95	0.79	1.15
Item True × Trait Anxiety*	-0.04	0.96	0.84	1.09
High Anxiety Prime × Trait Anxiety	0.04	1.04	0.89	1.21
Security Prime × Trait Anxiety	-0.01	0.99	0.85	1.15
Item True × High Anxiety Prime × Trait Anxiety	0.01	1.01	0.84	1.23
Item True × Security Prime × Trait Anxiety	0.12	1.12	0.93	1.35
Trait Avoidance	0.05	1.05	0.999	1.11

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), and the conditions were dummy coded with the “unprimed control group” as the reference group, these coefficients represent simple effects of each prime on *false* items, as compared with the unprimed control group.

\* Because the conditions were dummy coded with the “unprimed control group” as the reference condition, these effects represent the simple slopes of trait anxiety in the unprimed control group.

*Table 8b.* Study 2 interaction of both prime groups collapsed together with trait anxiety in predicting endorsement of memory items.

Predictor	<i>b</i>	Odds Ratio	95% CI	
			LB	UB
Intercept	<b>-0.78</b>	-	-	-
Item True	<b>1.92</b>	<b>6.79</b>	5.95	7.75
Primed†	0.05	1.05	0.92	1.20
Trait Anxiety*	0.03	1.03	0.92	1.14
Item True × Primed	-0.03	0.97	0.82	1.14
Item True × Trait Anxiety*	-0.04	0.96	0.84	1.09
Primed × Trait Anxiety	0.01	1.01	0.89	1.15
Item True × Primed × Trait Anxiety	0.07	1.07	0.91	1.29
Trait Avoidance	0.05	1.05	0.998	1.11

*Note.* CI = confidence interval; 95% CIs for parameters in **boldface** do not include 1.00.

† Because the “item true” variable was dummy coded (0 = false, 1 = true), this coefficient represents the simple effect of the primes on *false* items.

\* Because the conditions are dummy coded with the “unprimed control group” as the reference condition, these effects represent the simple slopes of anxiety in the unprimed control group.



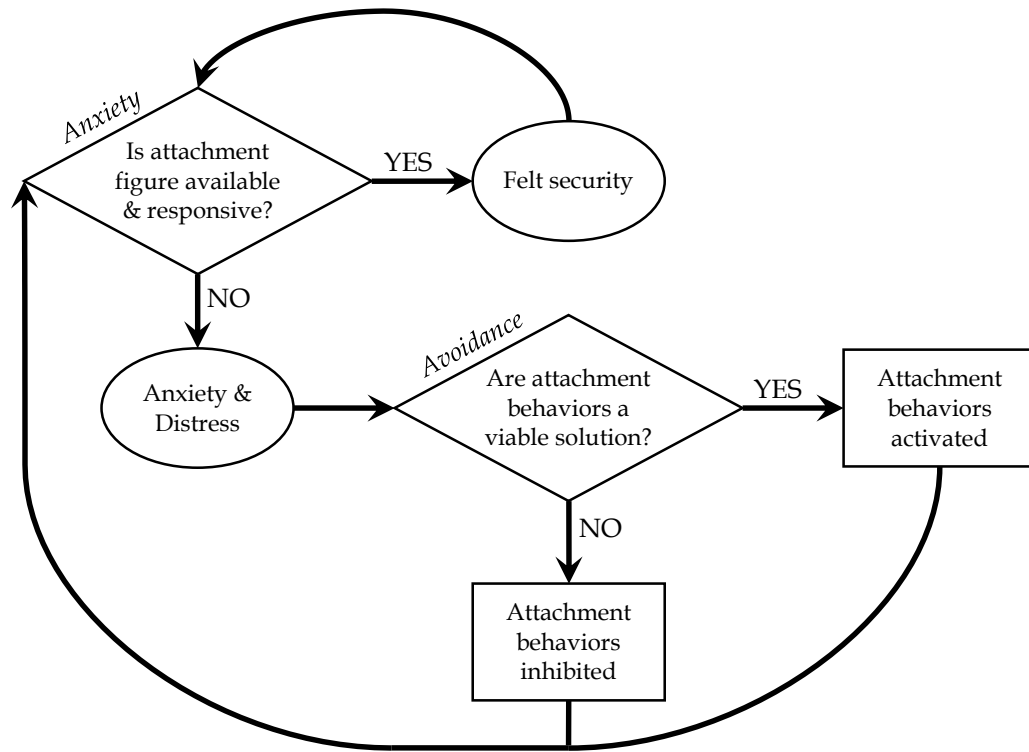
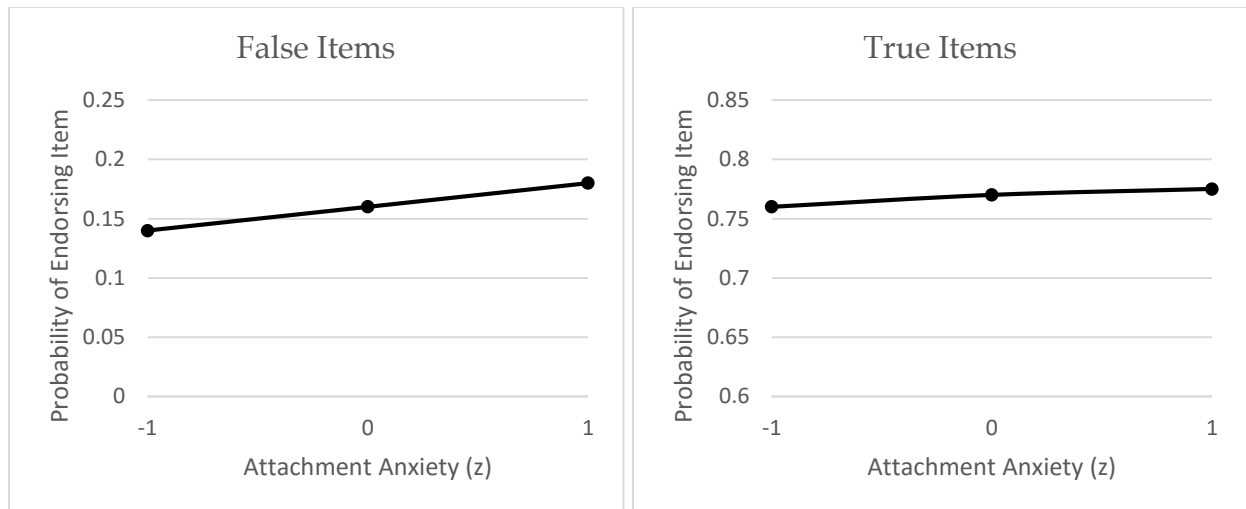


Figure 1. The attachment system (adapted from Fraley & Shaver, 2000).



*Figure 2.* Predicted probabilities of endorsing true and false items on a memory test as a function of standardized attachment anxiety; from Hudson and Fraley (in preparation).

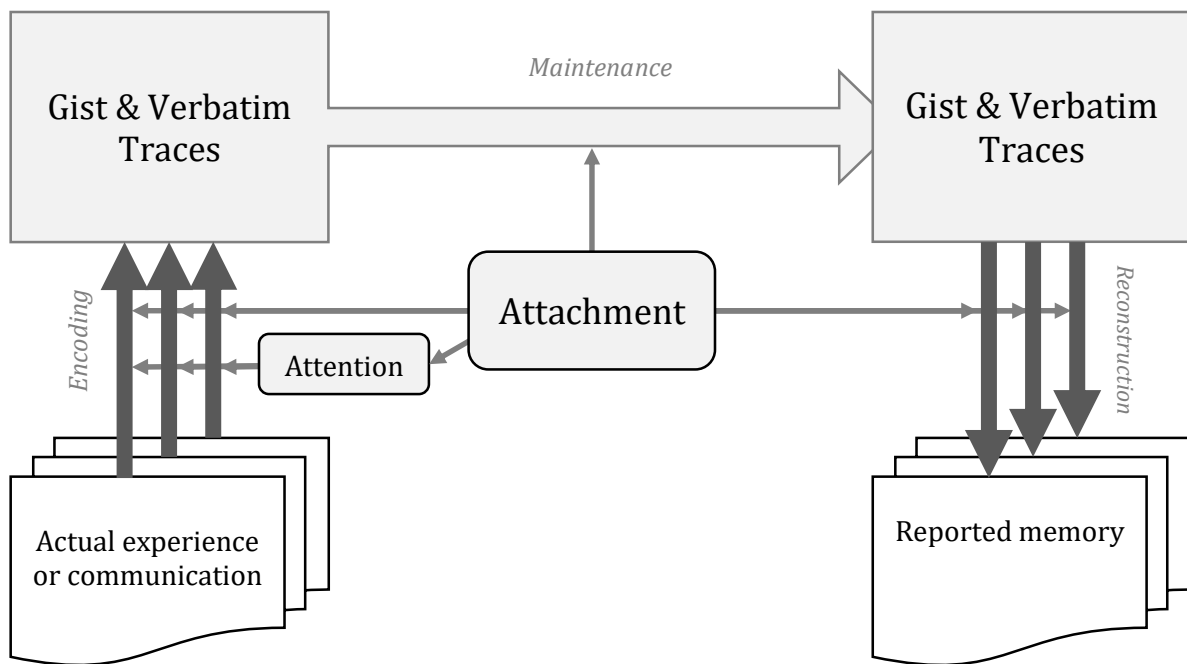
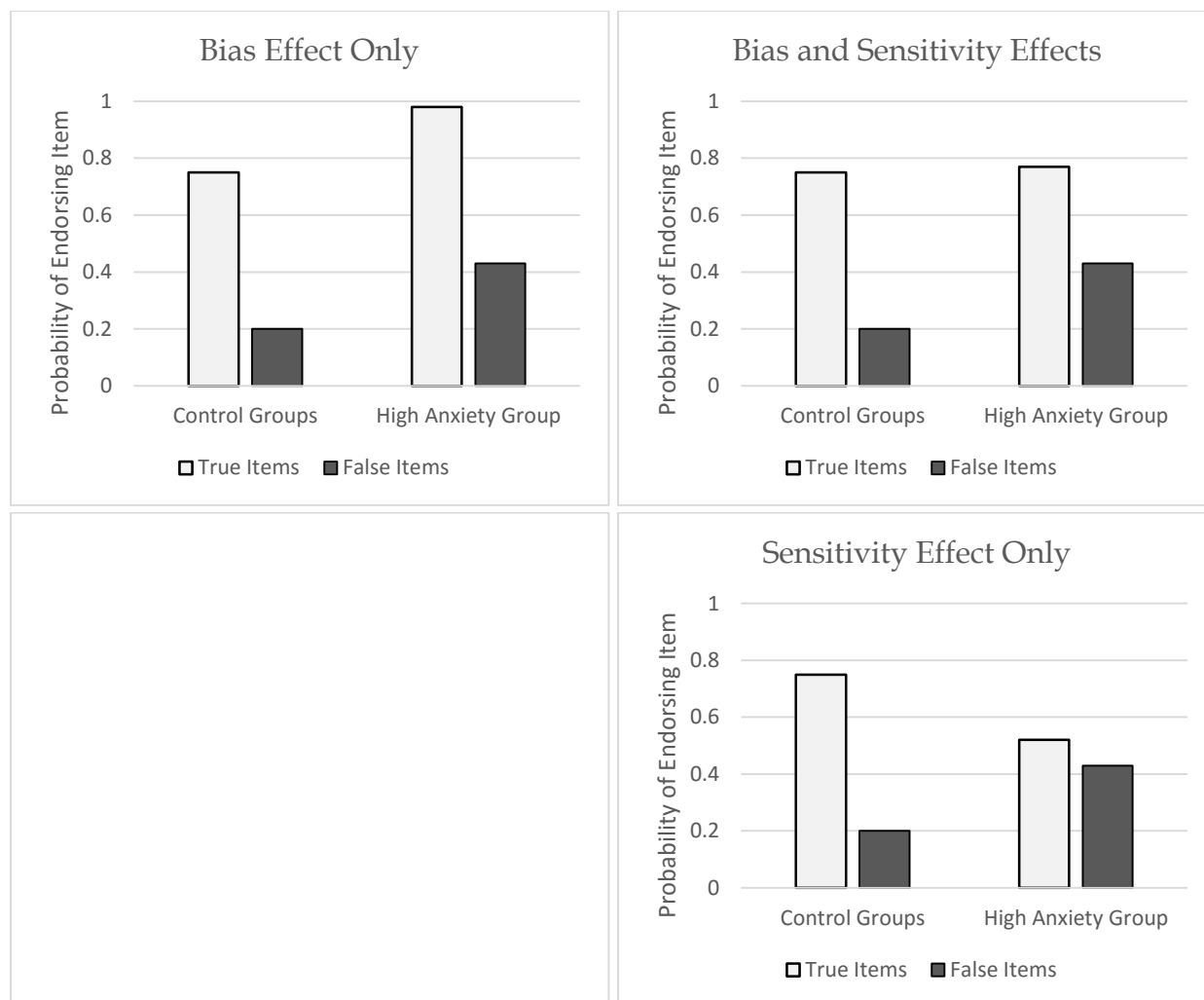
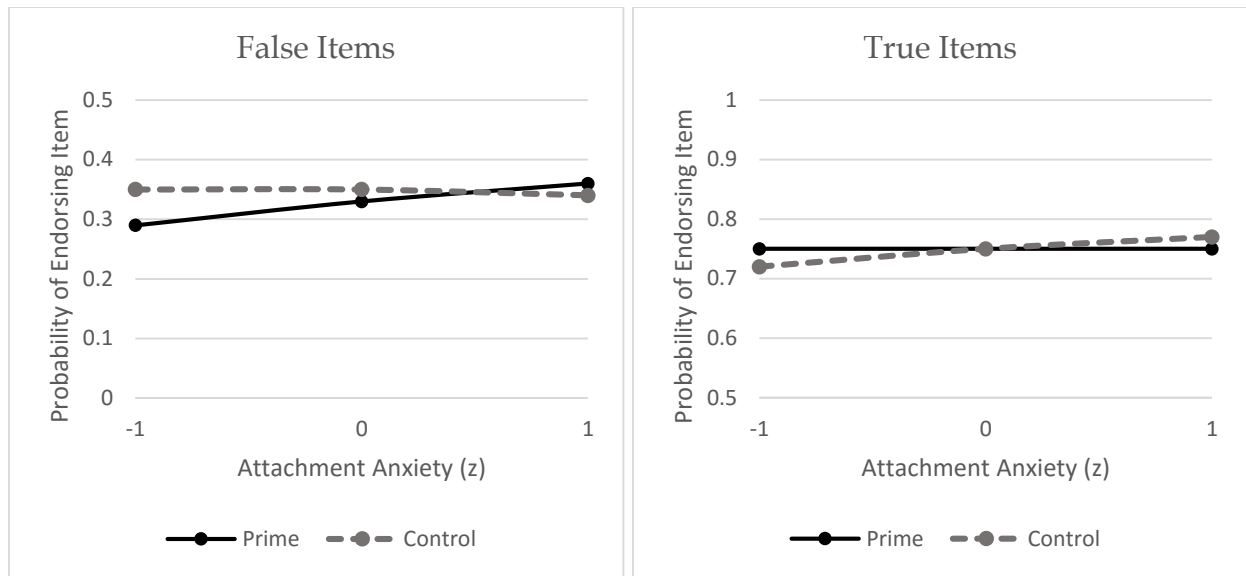


Figure 3. Theoretical model of the influence of the attachment system on false memories.



*Figure 4.* Illustration of how bias and sensitivity effects may manifest in the interaction between the attachment anxiety prime and item-veracity in predicting endorsement of false and true items.



*Figure 5.* Study 1 interaction between prime groups and attachment anxiety predicting endorsement of false and true items on memory test.

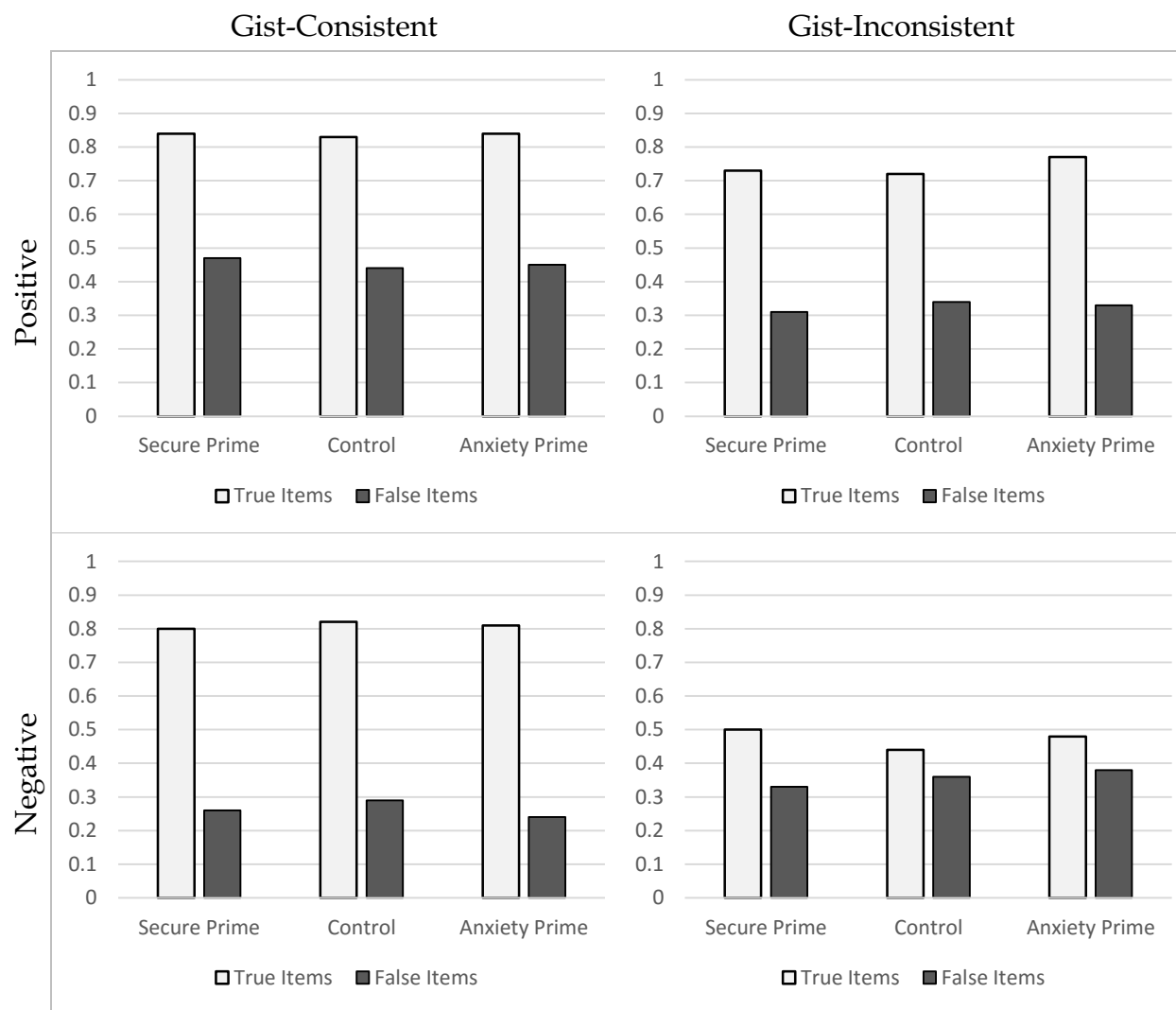
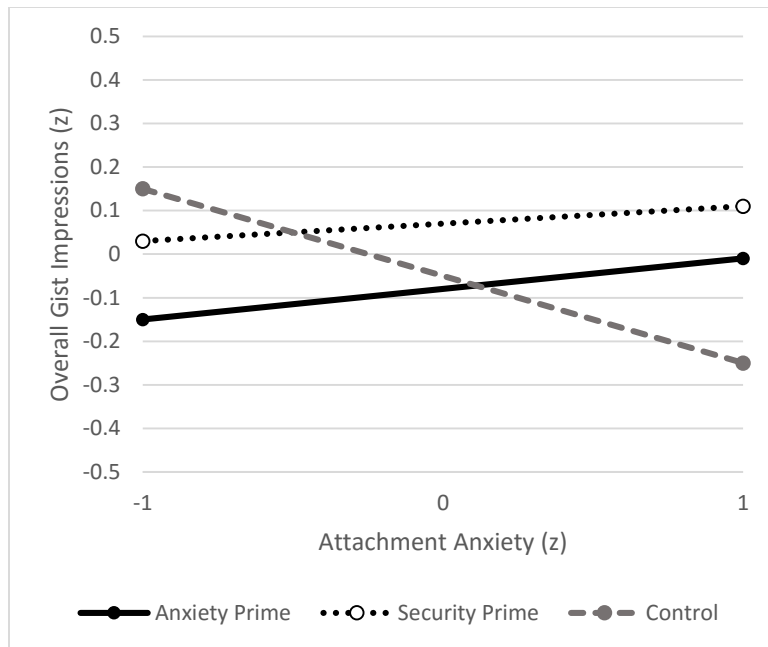


Figure 6. Study 1 false alarm rates and hit rates as a function of attachment prime and item veracity.



*Figure 7.* Study 2 interaction between primes and trait-level attachment anxiety in predicting overall gist impressions at Time 2.

**APPENDIX B: VERBATIM STUDY MATERIALS**

## 1. Demographics

1. What is your gender?
2. How old are you?
3. How would you best describe your ethnic or racial background? If you are of mixed ethnicity, check all that apply.
4. What is your current relationship status? Please check all that apply.
5. If you are currently in a romantic relationship (e.g., dating, engaged, or married), how long has your current relationship lasted?
6. If you have a romantic partner, what is your romantic partner's gender?
7. If you have a romantic partner, how would you best describe your romantic partner's ethnic or racial background? If your partner is of mixed ethnicity, check all that apply.
8. If you took the SAT, what was your total combined SAT score? If you did not take the SAT, just leave this question blank.
9. If you took the ACT, what was your total composite ACT score? If you did not take the ACT, just leave this question blank.
10. What is your current religious affiliation? Please check all that apply.
11. What country did you grow up in?

OR

If you grew up in the United States, which state did you grow up in?

12. How would you describe your hearing?
13. Please rate your overall ability in the English language.



## 2. Experiences in Close Relationships Short Form

*You will be presented with several statements with which you may agree or disagree. Please rate the extent to which you agree or disagree with each of the following statements.*

*Many of the following statements will ask you about your relationship with your romantic partner. If you are not currently in a romantic relationship, you may think about a previous romantic partner, your romantic relationships in general, or even your closest friend.*

1. I worry that romantic partners won't care about me as much as I care about them.
2. My desire to be very close sometimes scares people away.
3. I need a lot of reassurance that I am loved by my partner.
4. I do not often worry about being abandoned.
5. I find that my partner(s) don't want to get as close as I would like.
6. I get frustrated if romantic partners are not available when I need them.
7. I am nervous when partners get too close to me.
8. I try to avoid getting too close to my partner.
9. I usually discuss my problems and concerns with my partner.
10. It helps to turn to my romantic partner in times of need.
11. I turn to my partner for many things, including comfort and reassurance.
12. I want to get close to my partner, but I keep pulling back.

### 3. ECR-Relationship Structures

#### **Global subscale**

*For the following questions, please think about your close relationships in general (e.g., friends, family, romantic partners). Please tell us how you generally relate to other people.*

1. I often worry that other people don't really care for me.
2. I'm often afraid that other people may abandon me.
3. I worry that other people won't care about me as much as I care about them.
4. It helps to turn to other people in times of need.
5. I usually discuss my problems and concerns with other people.
6. I talk things over with other people.
7. I find it easy to depend on other people.
8. I don't feel comfortable opening up to other people.
9. I prefer not to show other people how I feel deep down.

#### **Partner-specific subscale**

*For the following questions, please think about your relationship with your romantic partner. If you do not currently have a romantic partner, you can think about your last romantic partner, or your romantic partners in general while answering these questions.*

1. I often worry that my romantic partner doesn't really care for me.
2. I'm often afraid that my romantic partner may abandon me.
3. I worry that my romantic partner won't care about me as much as I care about him or her.

4. It helps to turn to my romantic partner in times of need.
5. I usually discuss my problems and concerns with my romantic partner.
6. I talk things over with my romantic partner.
7. I find it easy to depend on my romantic partner.
8. I don't feel comfortable opening up to my romantic partner.
9. I prefer not to show my romantic partner how I feel deep down.

## 2. Big Five Inventory

### *How Do You See Yourself?*

*You will be presented with several statements that may or may not describe you and your personality. Please rate the extent to which each statement accurately describes your current personality.*

1. I see myself as someone who tends to find fault with others
2. I see myself as someone who is helpful and unselfish with others
3. I see myself as someone who starts quarrels with others
4. I see myself as someone who has a forgiving nature
5. I see myself as someone who is generally trusting
6. I see myself as someone who can be cold and aloof
7. I see myself as someone who is considerate and kind to almost everyone
8. I see myself as someone who is sometimes rude to others
9. I see myself as someone who likes to cooperate with others
10. I see myself as someone who is depressed, blue
11. I see myself as someone who is relaxed, handles stress well
12. I see myself as someone who can be tense

13. I see myself as someone who worries a lot
14. I see myself as someone who is emotionally stable, not easily upset
15. I see myself as someone who can be moody
16. I see myself as someone who remains calm in tense situations
17. I see myself as someone who gets nervous easily

### 3. Ten Item Personality Inventory

1. I see myself as extraverted, enthusiastic
2. I see myself as reserved, quiet
3. I see myself as dependable, self-disciplined
4. I see myself as disorganized, careless
5. I see myself as open to new experiences, complex
6. I see myself as conventional, uncreative

### 4. Gist Impressions of Victoria and James

*We'd like to ask you to rate your impressions of Victoria and James's personalities. Please rate your agreement with each of the following statements.*

*There are not correct or incorrect answers.*

1. I see Victoria as someone who is extraverted, enthusiastic
2. I see Victoria as someone who is reserved, quiet
3. I see Victoria as someone who tends to find fault with others
4. I see Victoria as someone who is helpful and unselfish with others
5. I see Victoria as someone who starts quarrels with others
6. I see Victoria as someone who has a forgiving nature
7. I see Victoria as someone who is generally trusting

8. I see Victoria as someone who is cold, aloof
9. I see Victoria as someone who is kind and considerate to almost everybody
10. I see Victoria as someone who is sometimes rude to others
11. I see Victoria as someone who likes to cooperate with others
12. I see Victoria as someone who is dependable, self-disciplined
13. I see Victoria as someone who is disorganized, careless
14. I see Victoria as someone who is depressed, blue
15. I see Victoria as someone who is relaxed, handles stress well
16. I see Victoria as someone who can be tense
17. I see Victoria as someone who worries a lot
18. I see Victoria as someone who is emotionally stable, not easily upset
19. I see Victoria as someone who can be moody
20. I see Victoria as someone who remains calm in tense situations
21. I see Victoria as someone who gets nervous easily
22. I see Victoria as someone who is open to new experiences, complex
23. I see Victoria as someone who is conventional, uncreative
24. I see Victoria as someone who worries that romantic partners won't really care for  
her
25. I see Victoria as someone who worries that romantic partners may abandon her
26. I see Victoria as someone who worries that romantic partners won't care as much  
about her as she cares about them
27. I see Victoria as someone who usually discusses her problems and concerns with  
her romantic partners

28. I see Victoria as someone who finds it easy to depend on romantic partners
29. I see Victoria as someone who prefers not to show romantic partners how she feels deep down
30. I see Victoria as someone who would comfort her romantic partners and make them feel better when they are upset
31. I see Victoria as someone who would make her romantic partners feel safe
32. I see Victoria as someone who would help make her romantic partners feel comfortable in new, unusual, or uncomfortable situations
33. I see Victoria as someone who is moral
34. I see Victoria as someone who is immoral
35. I see Victoria as someone who is loyal
36. I see Victoria as someone who is unfaithful
37. I see Victoria as someone who is trustworthy
38. I see Victoria as someone who is dishonest
39. I see Victoria as someone who is dependable
40. I see Victoria as someone who is loving
41. I see Victoria as someone who is caring
42. I see Victoria as someone who is heartless
43. I see Victoria as someone who is selfish
44. I see Victoria as someone who is immature
45. I see Victoria as someone who is aggressive
46. I see Victoria as someone who is passive
47. I see Victoria as someone who is hurtful

48. I see Victoria as someone who is upstanding
49. I see Victoria as someone who is mean/hostile
50. I see Victoria as someone who is basically a good person
51. I see James as someone who is extraverted, enthusiastic
52. I see James as someone who is reserved, quiet
53. I see James as someone who tends to find fault with others
54. I see James as someone who is helpful and unselfish with others
55. I see James as someone who starts quarrels with others
56. I see James as someone who has a forgiving nature
57. I see James as someone who is generally trusting
58. I see James as someone who is cold, aloof
59. I see James as someone who is kind and considerate to almost everybody
60. I see James as someone who is sometimes rude to others
61. I see James as someone who likes to cooperate with others
62. I see James as someone who is dependable, self-disciplined
63. I see James as someone who is disorganized, careless
64. I see James as someone who is depressed, blue
65. I see James as someone who is relaxed, handles stress well
66. I see James as someone who can be tense
67. I see James as someone who worries a lot
68. I see James as someone who is emotionally stable, not easily upset
69. I see James as someone who can be moody
70. I see James as someone who remains calm in tense situations

- 71. I see James as someone who gets nervous easily
- 72. I see James as someone who is open to new experiences, complex
- 73. I see James as someone who is conventional, uncreative
- 74. I see James as someone who worries that romantic partners won't really care for him
- 75. I see James as someone who worries that romantic partners may abandon him
- 76. I see James as someone who worries that romantic partners won't care as much about him as he cares about them
- 77. I see James as someone who usually discusses his problems and concerns with his romantic partners
- 78. I see James as someone who finds it easy to depend on romantic partners
- 79. I see James as someone who prefers not to show romantic partners how he feels deep down
- 80. I see James as someone who would comfort his romantic partners and make them feel better when they are upset
- 81. I see James as someone who would make his romantic partners feel safe
- 82. I see James as someone who would help make his romantic partners feel comfortable in new, unusual, or uncomfortable situations
- 83. I see James as someone who is moral
- 84. I see James as someone who is immoral
- 85. I see James as someone who is loyal
- 86. I see James as someone who is unfaithful
- 87. I see James as someone who is trustworthy



- 88. I see James as someone who is dishonest
- 89. I see James as someone who is dependable
- 90. I see James as someone who is loving
- 91. I see James as someone who is caring
- 92. I see James as someone who is heartless
- 93. I see James as someone who is selfish
- 94. I see James as someone who is immature
- 95. I see James as someone who is aggressive
- 96. I see James as someone who is passive
- 97. I see James as someone who is hurtful
- 98. I see James as someone who is upstanding
- 99. I see James as someone who is mean/hostile
- 100. I see James as someone who is basically a good person

## 5. Memory Quiz

*Did the following events occur?*

*We'd like to ask you a few questions about Victoria and James's relationship. The next few questions describe events that may or may not have occurred in Victoria and James's relationship.*

*Please indicate whether each of the following events did occur or did not occur, based on what Victoria said in the video. For each question, please rely only on what Victoria said while telling her story.*

*For example, if you saw the event "Victoria said James was a space alien," you should respond "No, this did NOT occur."*

**False Items**

1. According to Victoria, James was usually responsible and caring, except when he was drunk
2. Victoria said that James usually kept his promises to her, which made it surprising when he cheated
3. Victoria said that James took full responsibility for his negative actions, and tried to make amends
4. Victoria said that, even through the highs and lows, she always expected the best for her and James' relationship
5. Victoria said that while they dated, James went to the doctor with her to support her
6. Victoria said that James told her that he would never abandon her
7. Victoria said that, before he cheated, she fully trusted James
8. Victoria said that she felt that she was a very good girlfriend to James
9. According to Victoria, she and James were never particularly passionate with one another
10. Victoria said that James was sometimes too needy in their relationship
11. Victoria said that James was deliberate to a fault, and sometimes he could be too particular and controlling
12. Victoria said that, after James cheated on her, she felt numb and devoid of emotions
13. Victoria said that James was a relatively respectable and upstanding guy who was destroyed by his alcohol addiction

14. Victoria said that James was very passionate and occasionally bought her flowers
15. Victoria said that she loved James's spontaneity
16. Victoria said that she thought James was the love of her life
17. Victoria said that she and James were very interdependent with each other
18. Victoria said that she could have married James if things had worked out differently
19. Victoria said that James was uninvolved in planning any of the details of their wedding
20. Victoria said that James was angry with her for having cancer
21. According to Victoria, James got drunk and physically hit her
22. According to Victoria, after James promised that he wouldn't cheat on her, he cheated a second time
23. Victoria said that James frequently ignored her phone calls while they were dating
24. Victoria said that James promised to buy her a wedding dress, but broke that promise
25. Victoria said that she was very controlling and overbearing while dating James
26. Victoria said that James had no self-control in any domain of his life
27. According to Victoria, James said that he never really loved her
28. According to Victoria, James frequently fought with many of his friends

**True Items**

29. According to Victoria, James said that he wanted to make a deeper commitment to her

30. Victoria said that James mailed her stuffed animals and letters while they were dating
31. According to Victoria, James helped to plan some of the details of their wedding
32. Victoria said that, at one point, her relationship with James was very pleasant
33. Victoria said that, while dating James, she basically ruined everything all of the time because she was crazy
34. Victoria said that she wasn't trustworthy or loyal while she dated James
35. According to Victoria, after learning that James cheated on her, she was more mad at herself than at him
36. Victoria said that while she was dating James, she generally didn't care about other people's feelings
37. According to Victoria, while she and James dated, they spent nearly every day talking
38. Victoria said that her and James's relationship was very passionate
39. Victoria said that her relationship with James was very serious
40. Victoria said that she and James were very close
41. According to Victoria, James told her she should kill herself
42. Victoria said that she was not surprised that James cheated on her
43. According to Victoria, James called her a "stupid bitch"
44. Victoria said she felt that James lied to her about what he could and couldn't remember while drunk
45. According to Victoria, James once promised that he would never cheat on her, but broke that promise

46. According to Victoria, after she and James broke up, she had trouble letting go and continued to call and text him
47. According to Victoria, James told her via text message that he had cheated on her
48. Victoria said that she felt useless and hopeless in her relationship with James
49. Victoria burned all of the gifts that James had mailed her
50. Victoria called James, "not a real man"
51. Victoria said she did NOT regret her actions after she and James broke up
52. Victoria said she DID regret her actions after she and James broke up
53. Victoria said that she was devastated when James cheated on her
54. According to Victoria, she and James broke up and got back together once, before he cheated on her

#### 6. Attachment Style Prime

*We are interested in how your perceptions of other people's personalities are affected by the vividness of your imagination for certain elements of experiences.*

*In the following task, you will be guided through visualizing a past memory as vividly as is possible.*

*Afterwards, you will be asked a few questions about the vividness of your visualization experience.*

1. Please take a few moments to remember a real experience with a romantic partner, family member, or best friend, during which you felt feelings that match the description below:

**Secure.** I felt the person was relatively easy to feel close to. I felt comfortable depending on them and having them depend on me. I felt

confident they really loved me and would not abandon me and would not try to distance themselves from me. I felt comfortable with the level of closeness that we both wanted in the relationship.

**Anxious/Preoccupied.** I felt the person was reluctant to get as close as I would have liked. I felt worried that the person didn't really love me, or that they might try to distance themselves from me—perhaps even abandon me. I would've liked to have felt very close with this person, and I worried that my desire to be close might scare them away.

Everyone has had at least sometimes in their lives when they have felt this way.

Please pull a specific memory into mind that matches the description above. Take as much time as you need to think of a memory.

Once you have a memory in mind, please type a brief summary of the memory below. If you do not see the "Next" button below, please continue to reflect on the memory for a little while—the button will appear in a few moments.

## 2. **Visualization Audio Transcript:**

The following transcript was presented via a 5:30 minute audio file. Lines that differed in the anxiety visualization, as compared with the security visualization, are indicated with [square brackets]. The security audio and anxiety audio were recorded in a single take; any lines that differed were recorded serially (e.g., “Did you feel safe, and secure? Did you feel worried, or insecure?”), and the appropriate lines were edited out to create two audio files. As such, the vast majority of the audio file was literally identical across both conditions.

*This is a guided visualization.*

*During the visualization, you will hear my voice, followed by periods of silence.*

*Use the silence to re-experience—in your mind—the sights, sounds, and feelings from the event that you want to remember.*

*Please sit in a comfortable position.*

*If you feel comfortable doing so, let your eyes close.*

*Think about the experience with your close other that you want to visualize.*

*Where were you?*

*Can you picture your surroundings?*

...

*Picture the room, or whatever was around you.*

...

*What features pop out to you?*

...

*Pay attention to the colors; the details.*

...

*Now, focus your attention on the sounds from this memory.*

...

*What sounds were there?*

...

*Was there laughter, gentle conversation? [Were there angry voices? Strained conversation?]*

...

*Or was there the silence that sometimes accompanies the feeling of connectedness and love? [Or was there the silence that sometimes accompanies feeling worried about whether someone else truly cares about you?]*

...

*Try to rehear those sounds in your mind. Try to re-experience them right now.*

...

*Now, turn your attention inward.*

...

*Focus on the emotions you felt during this experience.*

...

*During this memory, how did you feel?*

...

*Did you feel safe, and secure? [Did you feel worried, or insecure?]*

...

*Did you feel connected and comfortable with your loved one? [Did you feel afraid that your loved one might not truly care about you?]*

...

*Try to experience these emotions again.*

...

*Feel them right now.*

...

*Give a name to the emotion.*

...



*Is it peace? [Is it fear?]*

*Or security? [Or anxiety?]*

...

*Try to recreate that feeling in your body right now.*

...

*Really feel the emotions again.*

...

*Where do you feel the emotion physically?*

...

*In your shoulders?*

...

*In your arms?*

...

*In your chest?*

...

*Now, shift your attention to integrating all of the elements of this memory into one whole.*

...

*Picture the scene in your mind's eye.*

*Hear the sounds.*

*And feel the emotions.*

...

*Remember what it was like to be in that moment.*

...

*And now, as this visualization draws to an end, open your eyes, but keep in mind all that you have re-experienced.*

*This concludes the visualization.*

3. How vividly were you able to see the setting of the memory in your mind?
  4. How vividly were you able to hear the sounds from the memory in your mind?
  5. How vividly did you feel the emotions from the memory?
  6. How positive was the memory you visualized?
  7. How would you rate your visualization experience?
7. Unprimed Control Group

*We are interested in how your perceptions of other people's personalities relate to how you perceive certain elements of experiences. In the following tasks, you will be presented with an audio clip, as well as a visual image. Please listen carefully to the audio clip, and study the image carefully. Be sure to pay attention to details for both.*

*Afterwards, you will be asked a few questions about your perceptions of the audio clip and the image.*

1. [4:40 instrumental music clip]

2. [Viewed for 90 seconds:]



3. How positive did you think the audio clip was?
4. How positive did you think the image was?
5. How engaging did you think the audio clip was?
6. How engaging did you think the image was?
7. How favorable did you feel about the audio clip?
8. How favorable did you feel about the image?
9. Did you prefer the audio clip or the image?